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IN THE

# District Court of the United States,

FOR THE MIDDLE DISTRICT OF PENNSYLVANIA.

---

No. 971. June Term, 1932.

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AMERICAN TRI-ERGON CORPORATION, TRI-ERGON HOLDING, A. G.,

*v.*

ALTOONA PUBLIX THEATRES, INC., ANASTASIUS N. NOTOPOULOS, AND GEORGE R. HUFFMAN.

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## DOCKET ENTRIES.

| | |
|---|---|
| Oct. 10, 1932. | Bill of Complaint. |
| Oct. 10, 1932. | Subpœna issued returnable 20 days after service. |
| Oct. 10, 1932. | Certified copy of Bill handed U. S. Marshal. (3). |
| Oct. 10, 1932. | Report to Commissioner of Patents. |
| Oct. 18, 1932. | Interrogatories on behalf of Plaintiffs and Order that interrogatories be filed and copies transmitted to each defendant by registered mail by Clerk & for filing 15 days after receipt of copies. |
| Oct. 18, 1932. | Copies mailed by registered mail to each of the three defendants, Grand Theatre, Huntingdon, Pa. |
| Oct. 18, 1932. | Subpœna returned served also copies of bill. |

Nov. 7, 1932. Stipulation and affidavit of Marion Close, that (1) plaintiffs interrogatories be withdrawn (2) that the bill of complaint be dismissed without prejudice as to defendants Anastasius N. Nortopoulos and George R. Huffman. (3) that the bill of complaint be amended accordingly by November 10, 1932. (4) that the sole remaining defendant, — Altoona Publix Theatres, Inc., be given until November 28, 1932, to file its answer or move to dismiss the bill upon the ground of misjoinder, and Order approving stipulation.

Nov. 11, 1932. Amended Bill of Complaint.

Nov. 26, 1932. Stipulation and agreement extending time to file answer to Dec. 7, 1932.

Dec. 7, 1932. Motion of Altoona Publix Theatres, Inc. to dismiss.

Dec. 7, 1932. Amended Bill of Complaint.

Dec. 8, 1932. Præcipe for appearance of O'Malley, Hill, Harris & Harris, Esqs., for Altoona Publix Theatres, Inc.

Jan. 10, 1933. Order fixing Jan. 31, 1933, at Scranton, Pa. as the time for hearing argument on motion to dismiss Amended Bill of Complaint.

Jan. 11, 1933. Certified copy of order.

Feb. 10, 1933. Plaintiff's Assignments and Agreements.

Feb. 10, 1933. Opinion and Order dismissing and overruling the motion to dismiss the Bill of Complaint and the de-

| | |
|---|---|
| | fendants are ordered to file their answer within 20 days. |
| Feb. 28, 1933. | Answer to amended Bill of Complaint. |
| Feb. 28, 1933. | Notice of taking depositions. |
| Apr. 4, 1933. | Plaintiff's petition waiving right to take depositions and asking for time of trial to be fixed and Order fixing June 12th, 1933 at 10 A. M. at Scranton, as the time for trial and that defendant take and file its depositions on or before May 15, 1933. |
| May 17, 1933. | Amended Answer and Order granting leave to file. |
| June 28, 1933. | Witnesses Lists. Nos. 1 to 12 Inc. |
| June 28, 1933. | Order dated June 22, 1933 amending answers. For order see case No. 972. |
| July 1, 1933. | Testimony, Vols. 1, 2, 3, 4 and 5. |
| Sept. 14, 1933. | Testimony Vols. 1 to 5, Inc. mailed Arthur G. Previn (Steno.), 15 Park Row, New York. (With permission of Judge Johnson). |
| Sept. 25, 1933. | Testimony Vols. 1 to 5 mailed Lewisburg. |
| Nov. 24, 1933. | Opinion and Order finding plaintiff's patent No. 1713726 valid and that claims 5, 7, 9, 13, 18, & 19 of the patent are infringed by defendants "PS-1 machine and that claims 9, 13, 17, 18, and 19 of the patent are infringed by defendants machine PS-16. It follows that plaintiffs are entitled to the |

usual decree for an injunction, reference, accounting and costs in accordance with this opinion.

Nov. 25, 1933. Statement of Marshal's fees and expenses ($22.10).

Nov. 24, 1933. Plaintiff's proposed findings of fact and conclusions of law.

Nov. 24, 1933. Defendants proposed findings of fact and conclusions of law.

Nov. 28, 1933. Order allowing both parties to withdraw exhibits, paper and physical, with the understanding that they will be retained for future use herein.

Nov. 29, 1933. Receipt for defendants exhibits.

Nov. 29, 1933. Receipt for Plaintiff's Exhibits.

Dec. 11, 1933. Testimony of Argument at Lewisburg, Sep. 29, 1933.

Dec. 15, 1933. Memorandum of corrections of opinion dated Nov. 24, 1933.

Dec. 16, 1933. Interlocutory Decree.

Dec. 16, 1933. Petition of Altoona Publix Theatres, Inc. for Appeal.

Dec. 16, 1933. Order allowing appeal, to act as a supersedas, and staying and suspending all proceedings pending appeal. $2,000.00 bond required.

Dec. 16, 1933. Bond in sum of $2000. and Order of Approval.

Dec. 16, 1933. Assignments of Error.

Dec. 16, 1933. Citation issued.

Dec. 18, 1933. Citation returned with acceptance of service thereon.

IN THE

DISTRICT COURT OF THE UNITED STATES,

FOR THE MIDDLE DISTRICT OF PENNSYLVANIA.

---

No. 972. June Term, 1932.

---

AMERICAN TRI-ERGON CORPORATION, TRI-ERGON HOLDING, A. G.,

*v.*

WILMER & VINCENT AMUSEMENT COMPANY, WILMER & VINCENT CORPORATION, AND LOCUST STREET REAL ESTATE COMPANY.

---

## DOCKET ENTRIES.

Oct. 10, 1932. Bill of Complaint.

Oct. 10, 1932. Subpœna issued returnable 20 days after service.

Oct. 10, 1932. Certified copies of Bill handed U. S. Marshal (3).

Oct. 10, 1932. Report to Commissioner of Patents.

Oct. 18, 1932. Interrogatories on behalf of plaintiffs and Order that interrogatories be filed and copies be transmitted to each defendant by registered mail by Clerk and for filing 15 days after receipt of copies.

Oct. 18, 1932. Copies mailed by registered mail to each of the three defendants, State Theatre, Harrisburg, Pa.

Oct. 18, 1932. Subpœna returned served, also copies of bill.

Nov. 7, 1932. Stipulation and Affidavit of Joseph D. Eagan, that (1) Plaintiffs interrogatories be withdrawn (2) Bill of Complaint herein be dismissed without prejudice as to Wilmer & Vincent Amusement Co. (3) that the Bill of Complaint be amended according by Nov. 10, 1932. (4) that the remaining defendants be given until Nov. 28, 1932 to answer or move to dismiss the bill upon the ground of misjoinder and Order approving the stipulation.

Nov. 11, 1932. Amended bill of complaint.

Nov. 26, 1932. Stipulation and agreement extending time to file answer to Dec. 7, 1932.

Dec. 7, 1932. Motion of Wilmer & Vincent Corporation and Locust Street Real Estate Co. to dismiss Bill of Complaint as amended.

Dec. 8, 1932. Præcipe for appearance of O'Malley, Hill, Harris & Harris, Esqs., for Wilmer & Vincent Corporation and Locust Street Real Estate Company.

Jan. 10, 1933. Order fixing Jan. 31, 1933 at Scranton, Pa. as the time for hearing argument upon the motion to dismiss amended bill of Complaint.

Jan. 11, 1933. Certified copy order.

Feb. 10, 1933. Opinion and Order dismissing & overruling the motion to dismiss

bill of Complaint and the defendant is ordered to file an answer within 20 days (For opinion see No. 971 E).

Feb. 16, 1933. Certified copies motion to dismiss & Opinion and Order.

Feb. 28, 1933. Answer to amended bill of complaint.

Feb. 28, 1933. Notice of taking depositions.

Apr. 4, 1933. Plaintiffs petition waiving right to take depositions and asking for time of trial to be fixed and Order fixing June 12, 1933 at 10 A. M. at Scranton as time for trial and that defendant take and file its depositions on or before May 15, 1933.

May 17, 1933. Amended Answer and Order granting leave to file.

June 28, 1933. Witness Lists. Nos. 1 to 12 inc., and Copy of first and fourth tests, etc.

June 28, 1933. Order dated June 22, 1933 amending answers.

July 1, 1933. Testimony, Vols. 1, 2, 3, 4 and 5 (See Case No. 971).

Nov. 24, 1933. Opinion and Order finding that the plaintiff patent No. 1713726 is valid and that claims 5, 7, 9, 13, 18 and 19 of the patent are infringed by defendant's PS-1 machine and that claims 9, 13, 17, 18, 19 of the patent are infringed by defendants machine PS 16. It follows that plaintiffs are entitled to the usual decree for an injunction, reference,

accounting and costs in accordance with this opinion. (For opinion See No. 971 E.)

Nov. 25, 1933. Statement of Marshal's Fees and Expenses $12.66.

Nov. 24, 1933. Plaintiffs proposed findings of fact & conclusions of law.

Nov. 24, 1933. Defendant's proposed findings of fact and conclusions of law.

Nov. 28, 1933. Order to withdraw Exhibits.

Nov. 29, 1933. Receipt for Defendants Exhibits.

Nov. 29, 1933. Receipt for Plaintiffs Exhibits.

Dec. 11, 1933. Testimony of Argument at Lewisburg, Sep. 29, 1933.

Dec. 15, 1933. Memorandum of corrections of Opinion dated Nov. 24, 1933.

Dec. 15, 1933. Interlocutory Decree.

Dec. 16, 1933. Petition of Wilmer & Vincent Corporation and Locust Street Real Estate Co. for Appeal and Order allowing appeal, to act as a supersedas and staying and suspending all proceedings pending appeal. $2000. bond required.

Dec. 16, 1933. Bond in the sum of $2000. and Order of Approval.

Dec. 16, 1933. Assignments of Error.

Dec. 16, 1933. Citation issued.

Dec. 18, 1933. Citation returned served with acceptance of service thereon.

## BILL OF COMPLAINT.

The original bill of complaint in suit No. 971, entitled American Tri-Ergon Corporation and Tri-Ergon Holding, A. G., plaintiffs, versus Altoona Publix Theatres, Inc., Anastasius N. Notopoulos, and George R. Huffman, defendants, was filed on October 10, 1932.

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## AMENDED BILL OF COMPLAINT.

### In Equity No. 971.

(Filed pursuant to stipulation herein dated November 1, 1932, and the Order of this Court based thereon, entered on November 7, 1932.)

AMERICAN TRI-ERGON CORPORATION and TRI-ERGON HOLDING, A. G., the plaintiffs above named, bring this their bill of complaint against the above-named defendant and allege as follows:

1. (a) That the plaintiff, American Tri-Ergon Corporation, is a corporation organized and existing under the laws of the State of New York, and is a citizen and an inhabitant of said State, having its place of business in the Borough of Manhattan, County and State of New York.

(b) That the plaintiff, Tri-Ergon Holding, A. G., is a corporation organized and existing under the laws of Switzerland, and is a citizen and an inhabitant of Switzerland, having its place of business at St. Gall., Switzerland.

(c) Upon information and belief, that the defendant Altoona Publix Theatres, Inc., is a corporation organized and existing under the laws of the State of

Delaware, with its principal office at the Paramount Building, in the Borough of Manhattan, County and State of New York, but having a regular and established place of business in the City of Huntingdon, County of Huntingdon and State of Pennsylvania, within the Middle District of Pennsylvania.

2. That the jurisdiction of the Court depends upon the patent laws of the United States.

3. (a) On information and belief, that Hans Vogt, then a resident of Berlin-Wilmersdorff, Germany, Joseph Massolle, then a resident of Berlin-Grunewald, Germany, and Josef Engl, then a resident of Berlin-Grunewald, Germany, all then and now being citizens of Germany, and being the true, original, first and joint inventors of certain new and useful improvements in devices for phonographs with linear phonogram carriers, and being then as such inventors the persons entitled by law to apply for and receive Letters Patent of the United States therefor, did in due form and apt time and in full compliance with the statutes in such cases made and provided, on March 20, 1922, file their application with the proper department of the Government of the United States for the grant to them of United States Letters Patent upon and for the aforesaid invention.

(b) On information and belief, that on or about the third day of June, 1924, said Hans Vogt, Joseph Massolle and Josef Engl jointly executed and delivered an assignment to Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), a corporation organized and existing under the laws of Switzerland and having its principal place of business at Zurich, Switzerland, said assignment conveying to said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), all right, title

and interest in and to the said United States patent application and the invention thereof, and all United States Letters Patent to be issued upon or for the same, and authorizing and requesting the Commissioner of Patents to issue any United States patent granted upon or for said invention, to said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), such assignment being duly recorded in the United States Patent Office on or about the twenty-third day of June, 1924, in Liber Z-121, page 309 of Transfers of Patents.

(c) On information and belief, that Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), being the owner of said application and invention as aforesaid, by a written license agreement dated on or about the eighth and fifteenth days of November, 1926, granted unto Tri-Ergon Musik, A. G., a corporation of Switzerland, the exclusive right to make, use and sell the said invention of said application for certain purposes only.

(d) That said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), being the owner of said application and the invention as aforesaid, by an agreement and assignment in writing, executed and delivered on or about the fourth day of September, 1928, and by a subsequent formal written assignment for recording, executed and delivered on or about the fifteenth day of February, 1929, and recorded in the United States Patent Office on or about April 17, 1929, in Liber X-138, page 240 of Transfers of Patents, sold, assigned and transferred to William Fox, of Woodsburgh, Nassau County, New York, all right, title and interest in and to said application and invention and United States Letters Patent to be granted therefor, subject to the aforesaid license to said Tri-Ergon Musik, A. G., and subject to the terms and conditions of said agreement of September 4, 1928.

(e) On information and belief, that after the filing thereof, such proceedings were had upon and pursuant to said patent application, and in due form and in full compliance with all the requirements of the law then in force, that on May 21, 1929, United States Letters Patent No. 1,713,726 were lawfully granted to said William Fox as assignee by mesne assignments from said Hans Vogt, Joseph Massolle and Josef Engl, for said invention, which letters patent are now in full force and effect.

(f) That said William Fox being the owner of said United States patent and invention as aforesaid, by an assignment in writing executed and delivered on or about the sixth day of June, 1930, and recorded in the United States Patent Office on or about July 3, 1930, in Liber T-144, page 192 of Transfers of Patents, sold, assigned and transferred unto plaintiff, American Tri-Ergon Corporation, subject to the terms and conditions of said agreement of September 4, 1928, all of the right, title and interest in and to said United States patent and the invention thereof, which had been assigned and issued to him as aforesaid, and in and to all rights of action which had then arisen or accrued by reason of any and all infringements of said letters patent (except as to any infringement upon the rights licensed as aforesaid to said Tri-Ergon Musik, A. G.), and in and to all damages and/or profits that had been accrued or arisen and that may be awarded by reason of any such infringements, together with the right to sue for and collect the same.

(g) On information and belief, that said Tri-Ergon Musik, A. G., being the owner of the aforesaid exclusive license, by an agreement heretofore made and by a subsequent formal written assignment agreement executed and delivered on or about the tenth day

of November, 1931, to take effect as of October 12, 1928, sold, assigned and transferred unto the plaintiff, Tri-Ergon Holding, A. G., all of its right, title and interest in, to and under said exclusive license.

(h) On information and belief, that by an agreement heretofore made and by a subsequent formal written assignment agreement executed and delivered on or about the tenth day of November, 1931, to take effect as of October 12, 1928, said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), sold, assigned and transferred unto the plaintiff, Tri-Ergon Holding, A. G., all of its right, title and interest in, to and under the aforesaid exclusive license agreement with said Tri-Ergon Musik, A. G., dated the eighth and fifteenth days of November, 1926.

(i) And that thereby the plaintiff, American Tri-Ergon Corporation (subject only to the aforesaid exclusive license for certain purposes only, owned by plaintiff, Tri-Ergon Holding, A. G.), became and now is the owner of all right, title and interest in, to and under said United States patent and the invention thereof, together with all the rights to damages and profits accrued or which may accrue by reason of any infringements of said letters patent, except as to any infringements upon the license rights owned by said Tri-Ergon Holding, A. G., as aforesaid; and that thereby the plaintiff, Tri-Ergon Holding, A. G., became and now is the owner of any and all rights under said letters patent other than those now owned as aforesaid by the plaintiff, American Tri-Ergon Corporation, and of all the rights to damages and profits accrued or which may accrue by reason of any infringements of such rights under said letters patent as are now owned by the plaintiff, Tri-Ergon Holding, A. G.; as by reference to said patent and to each and all of the aforesaid

assignments and instruments or duly certified or authenticated copies thereof, ready in court to be produced and of which profert hereby is made, will more fully appear.

4. On information and belief, plaintiffs' predecessors in title have put forth great efforts and have expended large sums of money in the development and perfection of the apparatus and methods described and covered by the aforesaid letters patent and in making the same useful to the public; that said predecessors in title have manufactured machines embodying the said apparatus and carrying out said methods, and have produced sound record film and reproduced sound therefrom, by the use of said apparatus and in accordance with said methods; that the same has caused said apparatus and methods and the products thereof to be favorably known; that plaintiff, American Tri-Ergon Corporation, has heretofore been engaged in the business of manufacturing machines embodying said apparatus and methods and is in a position to supply the demand for said machines, but is being deprived of its right and the opportunity so to do by the acts of infringement of defendant; wherefore, plaintiffs believe that they will realize large gains and profits from the rights conferred by the aforesaid letters patent if infringement by the defendant herein shall be prevented.

5. (a) Upon information and belief, that since the date of issue of the aforesaid letters patent and prior to the commencement of this suit, the said defendant, Altoona Publix Theatres, Inc., has been and now is infringing said letters patent by using, directing the use of, and causing to be used, at the "Grand" Theatre, a regular and established place of business of said defendant, at 715 Mifflin Street, in the City of Hunting-

don, County of Huntingdon, and State of Pennsylvania, and within the Middle District of Pennsylvania, and elsewhere within the United States, sound apparatus known as "R. C. A." reproducing machines "Type P. G. 30," including a "Sound Head P. S. 16" and also other forms and types of apparatus, and methods embodying and utilizing the invention described and claimed in said letters patent; all of said acts of said defendant being committed wilfully and with full knowledge of plaintiffs' rights and without license, authority or permission from the plaintiffs, or either of them, or their respective predecessors in title, and in violation of the plaintiffs' rights under said letters patent, and that said defendant threatens to continue to infringe upon the rights of the plaintiffs under said letters patent; said defendant all the while intending and well knowing its acts to be an infringement of the rights of plaintiffs under said letters patent; wherefore plaintiffs have suffered and are suffering great and irreparable loss, damage and injury; and that plaintiffs have been and still are being deprived of great gains and profits which they might and otherwise would have obtained, but which have been received and enjoyed and are being received and enjoyed by the said defendant by reason of its aforesaid unlawful acts and doings, but to what extent and how much exactly plaintiffs do not know and pray discovery thereof; all of which will continue unless further infringement by said defendant shall be enjoined.

6. (a) That said defendant has been duly notified of said Letters Patent No. 1,713,726, and of its infringement thereof in violation of plaintiffs' rights thereunder.

(b) On information and belief, that defendant has disregarded said notice and has continued after said

notice and threatens to continue to infringe upon plaintiffs' rights under said letters patent.

(c) Upon information and belief, that the aforesaid acts and doings of said defendant, and its preparation to continue the same in disregard and in defiance of plaintiffs' rights, have the effect to, and do encourage and induce others to infringe and continue to infringe upon the rights of plaintiffs under said letters patent.

7. To the end, therefore, that the plaintiffs may have such relief as they are entitled to in the premises, they pray:

(a) That a process of subpœna issue out of and under the seal of this Court, requiring said defendant, Altoona Publix Theatres, Inc., to appear and make full, true, correct and perfect answer to the several matters and things set forth and charged in this bill of complaint (but not under oath, an answer under oath being expressly waived).

(b) That the defendant, Altoona Publix Theatres, Inc., its officers, directors, servants, agents, confederates, and all persons, firms and corporations associated with or acting for or on behalf of said defendant, be perpetually enjoined and restrained by the decree of this Court, from directly or indirectly using, directing the use of, or causing to be used, all apparatus and/or methods embodying or employing the invention of said letters patent, and from infringing upon or contributing to the infringement of said letters patent in any manner whatsoever.

(c) That the defendant may be decreed to account for and pay over to plaintiffs all such gains, profits, and advantages as have accrued to or have been earned

or received by said defendant, and all such gains, profits and advantages as would have accrued to or been earned by the plaintiffs or either of them but for the said infringement of said defendant, and also all damages the plaintiffs, or either of them, have sustained by said infringement.

(d) That the defendant may be decreed to pay the charges, costs and disbursements of this cause, and that the plaintiffs may have such other and further relief as the premises and the equity of the case may require and to the Court may seem meet.

AMERICAN TRI-ERGON CORPORATION, TRI-ERGON HOLDING, A. G.

KAUFMAN & MATTES,
*Solicitors for Plaintiffs.*

Dated at Scranton, Pa.,
November , 1932.

S. MORTIMER WARD, JR.,
*Of Counsel,*
225 Broadway, New York, N. Y.

Dated at New York, N. Y., this tenth day of November, 1932.

Approved as to form:

CHARLES NEAVE,
per W. J. B.,
*Of Counsel for Defendant.*

## ANSWER.

The original answer in suit No. 971 was filed on February 28, 1933.

## AMENDED ANSWER.

**In Equity No. 971.**

The defendant, Altoona Publix Theatres, Inc., for answer to the amended bill of complaint herein says:

1. With respect to paragraph 1, defendant is without knowledge as to the allegations of subdivisions (a) and (b) thereof, and defendant denies, upon information and belief, the allegations of subdivision (c), except that it admits that it is a corporation of the State of Delaware.

2. Defendant admits the allegations of paragraph 2.

3. Defendant denies, upon information and belief, each and every allegation of paragraph 3 of the amended bill of complaint, except that it admits that United States Letters Patent No. 1,713,726 were issued on May 21, 1929.

4. Defendant denies, upon information and belief, each and every allegation contained in paragraphs 4 and 5.

5. With respect to paragraph 6, defendant admits that it has received a notice of alleged infringement of said Letters Patent No. 1,713,726 but defendant denies,

upon information and belief, each and every other allegation of said paragraph.

6. Defendant alleges, upon information and belief, that the amended bill of complaint herein is defective and should be dismissed for misjoinder of parties plaintiff, because the plaintiff, Tri-Ergon Holding, A. G., does not have sufficient interest in the subject-matter of the action and in obtaining the relief demanded, to be included as a party plaintiff herein, but on the contrary is an exclusive licensee in a field outside of and distinct from the field or fields in which the infringement is alleged to have occurred.

7. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void, because the patentees named therein were not the original, first and joint inventors of the alleged improvements disclosed and claimed therein, and that the same in all their material and substantial respects were known and used by others in this country before the alleged invention or discovery thereof by the said patentees; were patented and described in printed publications in this and foreign countries before the alleged invention or discovery thereof by the said patentees, and more than two years prior to the application for patent of said patentees; were in public use and on sale in this country more than two years prior to the said application for patent; were described in United States applications for patent filed in the United States Patent Office prior to the alleged invention or discovery thereof by the said patentees; were first patented or caused to be patented by the alleged inventors or their legal representatives or assigns in foreign countries upon applications filed more than twelve months prior to the filing of the application for said Letters Patent No. 1,713,726; and were abandoned.

(a) That the patents and printed publications above referred to, in so far as they have been ascertained are as follows:

UNITED STATES PATENTS.

| | | | |
|---|---|---|---|
| 200,521 | Edison | Feb. | 19, 1878 |
| 210,249 | Gally | Nov. | 26, 1878 |
| 227,679 | Edison | May | 18, 1880 |
| 255,220 | Wale | March | 21, 1882 |
| 261,568 | Snow | July | 25, 1882 |
| 299,013 | Robb | May | 20, 1884 |
| 341,213 | Bell & Tainter | May | 4, 1886 |
| 341,214 | Bell & Tainter | May | 4, 1886 |
| 341,288 | Tainter | May | 4, 1886 |
| 364,472 | Bock | June | 7, 1887 |
| 386,974 | Edison | July | 31, 1888 |
| 423,039 | Edison | March | 11, 1890 |
| 458,916 | Oxley | Sept. | 1, 1891 |
| 464,476 | Herrington | Dec. | 1, 1891 |
| 492,898 | Westinghouse | March | 7, 1893 |
| 499,879 | Edison | June | 20, 1893 |
| 502,382 | Randall | Aug. | 1, 1893 |
| 513,095 | Edison | Jan. | 23, 1894 |
| 534,543 | Berliner | Feb. | 19, 1895 |
| 551,946 | Cooley | Dec. | 24, 1895 |
| 565,657 | Ader | Aug. | 11, 1896 |
| 587,527 | Holst | Aug. | 3, 1897 |
| 597,875 | Clark | Jan. | 25, 1898 |
| 602,453 | Jones | Apr. | 19, 1898 |
| 605,484 | Jones | June | 14, 1898 |
| 691,667 | Rowland | Jan. | 21, 1902 |
| 707,389 | Churchward | Aug. | 19, 1902 |
| 724,645 | Wood | Apr. | 7, 1903 |
| 773,985 | Ries | Nov. | 1, 1904 |
| 867,682 | Spaulding | Oct. | 8, 1907 |
| 902,586 | Lanza | Nov. | 3, 1908 |
| 930,605 | Moore | Aug. | 10, 1909 |

| | | |
|---|---|---|
| 939,692 | Holman | Nov. 9, 1909 |
| 995,390 | Underhill | June 13, 1911 |
| 1,065,576 | Amet | June 24, 1913 |
| 1,075,692 | Cannock | Oct. 14, 1913 |
| 1,085,392 | Van Riper | Jan. 27, 1914 |
| 1,085,443 | Lanchester | Jan. 27, 1914 |
| 1,115,728 | Norton | Nov. 3, 1914 |
| 1,135,436 | Chabeault | Apr. 13, 1915 |
| 1,162,433 | Amet | Nov. 30, 1915 |
| 1,165,629 | Schneider | Dec. 28, 1915 |
| 1,175,205 | Turner et al. | March 14, 1916 |
| 1,185,056 | Byron | May 30, 1916 |
| 1,186,069 | Blair | June 6, 1916 |
| 1,186,982 | Hall | June 13, 1916 |
| 1,203,190 | Fritts | Oct. 31, 1916 |
| 1,221,407 | Amet | Apr. 3, 1917 |
| 1,246,217 | Anderson | Nov. 13, 1917 |
| 1,255,143 | Ebeling | Feb. 5, 1918 |
| 1,258,226 | Kamowski | March 5, 1918 |
| 1,256,613 | Terwilliger | Feb. 19, 1918 |
| 1,261,797 | Ebeling | Apr. 9, 1918 |
| 1,273,328 | Cameron | July 23, 1918 |
| 1,273,627 | Langmuir | July 23, 1918 |
| 1,286,527 | Burton et al. | Dec. 3, 1918 |
| 1,292,448 | Emory | Jan. 28, 1919 |
| 1,317,450 | Momyer | Sept. 30, 1919 |
| 1,346,755 | Lanchester | July 13, 1920 |
| 1,355,523 | Arthur | Oct. 12, 1920 |
| 1,366,446 | Collins | Jan. 25, 1921 |
| 1,367,863 | Clark | Feb. 8, 1921 |
| 1,372,619 | Hoestetter | March 22, 1921 |
| 1,381,474 | Kunz | June 14, 1921 |
| 1,388,515 | Clark | Aug. 23, 1921 |
| 1,425,177 | Constable | Aug. 8, 1922 |
| 1,447,913 | Trowbridge et al. | March 6, 1923 |
| 1,449,327 | Jaycox et al. | March 20, 1923 |
| 1,473,976 | Ries | Nov. 13, 1923 |

| | | | |
|---|---|---|---|
| 1,567,424 | Compton | Dec. | 29, 1925 |
| 1,594,662 | Cawley | Aug. | 3, 1926 |
| 1,607,480 | Ries | Nov. | 16, 1926 |
| 1,710,677 | Cawley | Apr. | 23, 1929 |
| 1,825,438 | Cawley | Sept. | 29, 1931 |
| 1,825,439 | Cawley | Sept. | 29, 1931 |
| 1,825,440 | Cawley | Sept. | 29, 1931 |
| 1,825,441 | Cawley | Sept. | 29, 1931 |
| 1,878,577 | Cawley | Sept. | 20, 1932 |

FOREIGN PATENTS.

BRITISH.

| | | |
|---|---|---|
| 1,644 | Edison | of 1878 |
| 2,814 | Jamieson et al. | of 1884 |
| 21,371 | Baron | of 1898 |
| 24,546 | Duddell | of 1902 |
| 3,701 | Polyphos | of 1908 |
| 5,029 | Royce | of 1911 |
| 15,333 | Royce | of 1912 |
| 115,942 | Pedersen | of 1918 |
| 157,433 | Vogt et al. | Applied for in 1921 |

FRENCH.

| | | |
|---|---|---|
| 319,425 | Buss | 1902 |
| 393,301 | Fabbrica etc. Parlate | 1908 |
| 10,377 | Fabbrica etc. Parlate | 1909 |
| 414,788 | Comp. Gen. de Phon. | 1910 |
| 416,838 | Martinez | 1910 |
| 472,467 | Dragoumis | 1914 |
| 532,172 | Vogt et al. | Applied for in 1921 |

GERMAN.

| | | |
|---|---|---|
| 363,640 | Aftergut | 1922 |
| 387,058 | Vogt et al. | Applied for in 1920 |
| 417,967 | Vogt et al. | Applied for in 1919 |

SWISS.

85,751 Alber 1920

SWEDISH.

64,802 Vogt et al. Applied for Dec. 31, 1920

NORWEGIAN.

36,326 Vogt et al. Applied for Dec. 30, 1920

PUBLICATIONS.

Scientific American Supplement No. 133, July 20, 1878, pages 2112 and 2113.

Scientific American, June 18, 1881, page 394.

La Nature No. 1266, September 4, 1897, pages 209 to 211, inc.

La Nature No. 1288, February 5, 1898, page 158.

The Electric Journal, Vol. XI, No. 5, May, 1914, pages 262 and 263.

Physical Review, Vol. 10, No. 2, August, 1917, pages 205 and 206.

Proceedings of the Physical Society, Vol. XXXII, 1920, pages 78 to 81, inc.

(b) That the instances of prior invention, knowledge, use and sale above referred to in so far as they have been ascertained are as follows:

By the patentees of the patents and by the authors of the publications in subdivision (a) above at the places therein stated and elsewhere in the United States.

By Eugene Lauste of Bloomfield, New Jersey at Bloomfield, New Jersey, and elsewhere in the United States.

By Delmar A. Whitson of Los Angeles, California, at Los Angeles, California, and elsewhere in the United States.

By Alfred E. Oswald of Hackensack, New Jersey, at Bogota, New Jersey, and elsewhere in the United States.

By Alfred C. Clark of New York, New York, at New York, New York, and elsewhere in the United States.

By Emile Berliner of Washington, D. C., at Washington, D. C., and elsewhere in the United States.

By William M. Clark, of South Orange, New Jersey, at South Orange, New Jersey, and elsewhere in the United States.

By Anthony J. Weber, of Bloomfield, New Jersey, at Orange, New Jersey, New York, New York, and elsewhere in the United States.

By George K. Thompson, of Maplewood, New Jersey, at New York, New York, and elsewhere in the United States.

By Edison Phonograph Company, of Orange, New Jersey, at Orange, New Jersey, and elsewhere in the United States.

By Thomas A. Edison, Inc., of Orange, New Jersey, at Orange, New Jersey, and elsewhere in the United States.

By Victor Talking Machine Company of Camden, New Jersey, at Camden, New Jersey, and elsewhere in the United States.

By Underwood Typewriter Company of New York, New York, at New York, New York, and elsewhere in the United States.

By American Telephone & Telegraph Company of New York, New York, at New York, New York, and elsewhere in the United States.

By Western Electric Company, Incorporated, of New York, New York, at New York, New York, and elsewhere in the United States.

By General Electric Company, of New York, New York, at Schenectady, New York, and elsewhere in the United States.

By Nicholas Power Company of New York, New York, at New York, New York, and elsewhere in the United States.

By Precision Machine Company of New York, New York, at New York, New York, and elsewhere in the United States.

By Bergmann & Company of New York, New York, at New York, New York, and elsewhere in the United States.

By Advertising Record Corp. of New York, New York, at New York, New York, and elsewhere in the United States.

By Talking Book Corp. of New York, New York, at New York, New York, and elsewhere in the United States.

By Columbia Phonograph Company of Bridgeport, Connecticut, at Bridgeport, Connecticut, and elsewhere in the United States.

By Smithsonian Institute, United States National Museum of Washington, D. C., at Washington, D. C., and elsewhere in the United States.

(c) That the applications for patents above referred to, in so far as they have been ascertained are as follows:

The applications for Letters Patent of the United States listed in subdivision (a) above.

(d) That the above referred to foreign patents obtained by the alleged inventors or their legal representatives or assigns, in so far as they have been

ascertained are as follows: German Patent No. 387,058 for which the application was filed in Germany on May 23, 1920; German Patent No. 417,967 for which the application was filed in Germany on March 4, 1919; British Patent No. 157,433 for which the application was filed in Great Britain on January 10, 1921; French Patent No. 532,172 for which the application was filed in France on March 15, 1921; Swedish Patent No. 64,-80. for which the application was filed in Sweden on December 31, 1920; Norwegian Patent No. 36,326 for which the application was filed in Norway on December 30, 1920; Italian Patent corresponding to German Patent No. 417,967 for which the application was filed in Italy on January 29, 1921; Belgian patent corresponding to German Patent No. 417,967 for which the application was filed in Belgium on December 24, 1920.

8. Defendant alleges, upon information and belief, that by reason of the proceedings in the United States Patent Office during the prosecution of the application which resulted in said Letters Patent No. 1,713,726, and the admissions and representations therein made by or in behalf of the alleged inventors in order to induce the grant of the said letters patent, the plaintiffs are estopped to claim for said letters patent a construction, were the same otherwise possible, as would cause said letters patent to cover or include any machine or device manufactured, used or sold by the defendant.

9. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the alleged improvements described and claimed therein did not constitute patentable subject-matter within the meaning of the Patent Laws, in view of the prior state of the art and what was common knowledge on the part of those skilled in the

art; all prior to the date of the alleged invention thereof by the patentees named therein.

10. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void, or cannot be given a valid interpretation which would bring any devices or acts of the defendant within the scope thereof, because the alleged invention described and claimed in said letters patent was not described or claimed in the original application as filed, upon which said letters patent were granted, but on the contrary constitutes new matter illegally and unjustifiably added to the said application subsequent to the filing thereof.

11. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the alleged invention described and claimed therein is inoperative and incapable of producing any new or useful result.

12. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the alleged invention is not described therein in such full, clear and exact terms as to enable any person skilled in the art or science to which it appertains to make, construct or use the same.

13. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the specification and claims thereof are indefinite, ambiguous and uncertain and do not particularly point out and distinctly claim the alleged invention or discovery.

14. Defendant alleges, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and unenforcible because of intervening rights arising prior to the issuance of said letters patent.

WHEREFORE, the defendant prays that the amended bill of complaint herein be dismissed with costs to the defendant.

ALTOONA PUBLIX THEATRES, INC.,

By (Sgd.) CHARLES NEAVE
By H. R. A.
*Counsel for Defendant.*

May 11, 1933.

REESE H. HARRIS,
*Solicitor for Defendant.*

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## BILL OF COMPLAINT.

### In Equity No. 972.

American Tri-Ergon Corporation and Tri-Ergon Holding, A. G., the plaintiffs above named, bring this their bill of complaint against the above-named defendants and allege as follows:

1 (a). That the plaintiff, American Tri-Ergon Corporation, is a corporation organized and existing under the laws of the State of New York, and is a citizen and an inhabitant of said state, having its place of business in the Borough of Manhattan, County and State of New York.

(b). That the plaintiff, Tri-Ergon Holding, A. G., is a corporation organized and existing under the laws of Switzerland, and is a citizen and an inhabitant of Switzerland, having its place of business at St. Gall., Switzerland.

(c). Upon information and belief, ~~that the defendant Wilmer & Vincent Amusement Company is a corporation organized and existing under the laws of the State of Pennsylvania, with its principal place of business in the city of Harrisburg, County of Dauphin, State of Pennsylvania, and within the Middle District of Pennsylvania,~~ that the defendant, Wilmer & Vincent Corporation, is a corporation organized and existing under the laws of the State of Delaware, having its main office at 1451 Broadway, Borough of Manhattan, County and State of New York, but having a regular and established place of business in the City of Harrisburg, County of Dauphin and State of Pennsylvania, and within the Middle District of Pennsylvania; and that the defendant Locust Street Real Estate Company is a corporation organized and existing under the laws of the State of Pennsylvania and having its principal place of business in the city of Harrisburg, County of Dauphin and State of Pennsylvania, and within the Middle District of Pennsylvania.

2. That the jurisdiction of the Court depends upon the patent laws of the United States.

3 (a). On information and belief, that Hans Vogt, then a resident of Berlin-Wilmersdorff, Germany, Joseph Massolle, then a resident of Berlin-Grunewald, Germany, and Josef Engl, then a resident of Berlin-Grunewald, Germany, all then and now being citizens of Germany, and being the true, original, first and joint inventors of certain new and useful improvements in devices for phonographs with linear phonogram carriers, and being then as such inventors the persons entitled by law to apply for and receive letters patent of the United States therefor, did in due form and apt time and in full compliance with the statutes in such cases made and provided, on March 20, 1922,

file their application with the proper department of the Government of the United States for the grant to them of United States Letters Patent upon and for the aforesaid invention.

(b). On information and belief, that on or about the third day of June, 1924, said Hans Vogt, Joseph Massolle and Josef Engl jointly executed and delivered an assignment to Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), a corporation organized and existing under the laws of Switzerland and having its principal place of business at Zurich, Switzerland, said assignment conveying to said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), all right, title and interest in and to the said United States patent application and the invention thereof, and all United States Letters Patent to be issued upon or for the same, and authorizing and requesting the Commissioner of Patents to issue any United States patent granted upon or for said invention, to said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), such assignment being duly recorded in the United States Patent Office on or about the twenty-third day of June, 1924, in Liber Z-121, page 309, of Transfers of Patents.

(c). On information and belief, that Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), being the owner of said application and invention as aforesaid, by a written license agreement dated on or about the eighth and fifteenth days of November, 1926, granted unto Tri-Ergon Musik, A. G., a corporation of Switzerland, the exclusive right to make, use and sell the said invention of said application for certain purposes only.

(d). That said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), being the owner of said

application and the invention as aforesaid, by an agreement and assignment in writing, executed and delivered on or about the fourth day of September, 1928, and by a subsequent formal written assignment for recording, executed and delivered on or about the fifteenth day of February, 1929, and recorded in the United States Patent Office on or about April 17, 1929, in Liber X-138, page 240, of Transfers of Patents, sold, assigned and transferred to William Fox, of Woodsburgh, Nassau County, New York, all right, title and interest in and to said application and invention and United States Letters Patent to be granted therefor, subject to the aforesaid license to said Tri-Ergon Musik, A. G., and subject to the terms and conditions of said agreement of September 4, 1928.

(e). On information and belief, that after the filing thereof, such proceedings were had upon and pursuant to said patent application, and in due form and in full compliance with all the requirements of the law then in force, that on May 21, 1929, United States Letters Patent No. 1,713,726 were lawfully granted to said William Fox as assignee by mesne assignments from said Hans Vogt, Joseph Massolle and Josef Engl, for said invention, which letters patent are now in full force and effect.

(f). That said William Fox being the owner of said United States patent and invention as aforesaid, by an assignment in writing executed and delivered on or about the sixth day of June, 1930, and recorded in the United States Patent Office on or about July 3, 1930, in Liber T-144, page 192, of Transfers of Patents, sold, assigned and transferred unto plaintiff, American Tri-Ergon Corporation, subject to the terms and conditions of said agreement of September 4, 1928, all of the right, title and interest in and to said United

States patent and the invention thereof, which had been assigned and issued to him as aforesaid, and in and to all rights of action which had then arisen or accrued by reason of any and all infringements of said letters patent (except as to any infringement upon the rights licensed as aforesaid to said Tri-Ergon Musik, A. G.), and in and to all damages and/or profits that had been accrued or arisen and that may be awarded by reason of any such infringements, together with the right to sue for and collect the same.

(g). On information and belief, that said Tri-Ergon Musik, A. G., being the owner of the aforesaid exclusive license, by an agreement heretofore made and by a subsequent formal written assignment agreement executed and delivered on or about the tenth day of November, 1931, to take effect as of October 12, 1928, sold, assigned and transferred unto the plaintiff, Tri-Ergon Holding A. G., all of its right, title and interest in, to and under said exclusive license.

(h). On information and belief, that by an agreement heretofore made and by a subsequent formal written assignment agreement executed and delivered on or about the tenth day of November, 1931, to take effect as of October 12, 1928, said Tri-Ergon, Limited (otherwise known as Tri-Ergon, A. G.), sold, assigned and transferred unto the plaintiff, Tri-Ergon Holding, A. G., all of its right, title and interest in, to and under the aforesaid exclusive license agreement with said Tri-Ergon Musik A. G., dated the eighth and fifteenth days of November, 1926.

(i). And that thereby the plaintiff, American Tri-Ergon Corporation (subject only to the aforesaid exclusive license for certain purposes only, owned by plaintiff, Tri-Ergon Holding, A. G.), became and now

is the owner of all right, title and interest in, to and under said United States patent and the invention thereof, together with all the rights to damages and profits accrued or which may accrue by reason of any infringements of said letters patent, except as to any infringements upon the license rights owned by said Tri-Ergon Holding, A. G., as aforesaid; and that thereby the plaintiff, Tri-Ergon Holding, A. G., became and now is the owner of any and all rights under said letters patent other than those now owned as aforesaid by the plaintiff, American Tri-Ergon Corporation, and of all the rights to damages and profits accrued or which may accrue by reason of any infringements of such rights under said letters patent as are now owned by the plaintiff, Tri-Ergon Holding, A. G.; as by reference to said patent and to each and all of the aforesaid assignments and instruments or duly certified or authenticated copies thereof, ready in court to be produced and of which profert hereby is made, will more fully appear.

4. On information and belief, plaintiffs' predecessors in title have put forth great efforts and have expended large sums of money in the development and perfection of the apparatus and methods described and covered by the aforesaid letters patent and in making the same useful to the public; that said predecessors in title have manufactured machines embodying the said apparatus and carrying out said methods, and have produced sound record film and reproduced sound therefrom, by the use of said apparatus and in accordance with said methods; that the same has caused said apparatus and methods and the products thereof to be favorably known; that plaintiff, American Tri-Ergon Corporation, has heretofore been engaged in the business of manufacturing machines embodying said apparatus and methods and is in a position to

supply the demand for said machines, but is being deprived of its right and the opportunity so to do by the acts of infringement of defendants; wherefore, plaintiffs believe that they will realize large gains and profits from the rights conferred by the aforesaid letters patent if infringement by the defendants herein shall be prevented.

5 (a). Upon information and belief, that since the date of issue of the aforesaid letters patent and prior to the commencement of this suit, the said defendants, ~~Wilmer & Vincent Amusement Company,~~ Wilmer & Vincent Corporation, and Locust Street Real Estate Company, have been and now are jointly and severally infringing and contributing to the infringement of said letters patent by using, directing the use of, aiding and abetting each other and conspiring with each other in the use of, and causing to be used, at various theatres including the "State" Theatre, regular and established places of business of said defendants, in the city of Harrisburg, County of Dauphin and State of Pennsylvania, within the Middle District of Pennsylvania, and elsewhere within the United States, sound reproducing apparatus known as "R. C. A." reproducing machines "Type P. G. 3" including a "sound head P. S. 1," and also other forms and types of apparatus and methods embodying and utilizing the invention described and claimed in said letters patent; all of said acts of said defendants being committed without license, authority or permission from the plaintiffs, or either of them, or their respective predecessors in title, and in violation of the plaintiffs' rights under said letters patent, and that said defendants threaten to continue to infringe upon the rights of the plaintiffs under said letters patent, said defendants all the while intending and well knowing their acts to be an infringement of the rights of the

plaintiffs under said letters patent; wherefore plaintiffs have suffered and are suffering great and irreparable loss, damage and injury; and that plaintiffs have been and still are being deprived of great gains and profits which they might and otherwise would have obtained, but which have been received and enjoyed and are being received and enjoyed by the said defendants by reason of their aforesaid unlawful acts and doings, but to what extent and how much exactly plaintiffs do not know and pray discovery thereof; all of which will continue unless further infringement by said defendants shall be enjoined.

5 (b). Plaintiffs are informed; that within the period during which said infringement is charged, as set forth in paragraph 5 (a) supra, and at the present time, the defendant, Wilmer & Vincent Amusement Company, has been and is infringing said letters patent by operating said "State" Theatre and utilizing therein the machines and methods above complained of, and by operating other machines in the Middle District of Pennsylvania and elsewhere within the United States, and is the party who signed a contract for the use of said machines used in said "State" Theatre; and that the defendant, Wilmer & Vincent Corporation, within the period during which said infringement is charged as set forth in said paragraph 5 (a) and at the present time, owns the majority of the stock of the said defendant, Wilmer & Vincent Amusement Company, and absolutely dominates, controls and dictates and directs the policy and acts of the same, including the alleged infringing acts above complained of, and caused said defendant, Wilmer & Vincent Amusement Company, to enter into said contract for the use of said machines in the "State" Theatre above complained of, and for the use of other infringing machines within the said Middle District of Pennsylvania; and that said

defendant, Wilmer & Vincent Amusement Company, is a mere department of said Wilmer & Vincent Corporation for operating certain theatres including the said "State" Theatre in the Middle District of Pennsylvania, in a manner decided by and at the direction of said Wilmer & Vincent Corporation; that the defendant, Locust Street Real Estate Company, is the owner of said "State" Theatre and has collaborated and conspired with said other two defendants in acquiring said contract for the operation in said "State" Theatre, of said infringing machines above complained of, and is still collaborating and conspiring with said other two defendants in the operation of said machines at said theatre; and that the manager of said "State" Theatre for each of said defendant corporations, is one C. Floyd Hopkins, a resident of said City of Harrisburg; and that each of said three defendants have been and are collaborating and conspiring with each other in their joint and several infringements of said letters patent at said "State" Theatre and elsewhere within the Middle District of Pennsylvania; but plaintiffs from other sources are also informed that said defendant, Wilmer & Vincent Corporation, is the party who, within the period during which said infringement is charged, as set forth in said paragraph 5 (a) and at the present time, has been and is infringing said letters patent, by operating said "State" Theatre and utilizing therein the machines complained of, and by operating said other infringing machines in the Middle District of Pennsylvania and elsewhere, which plaintiffs were otherwise informed were operated by defendant, Wilmer & Vincent Amusement Company; and plaintiffs are further informed from still other sources, that the defendant, Locust Street Real Estate Company, is the party who, within the period during which said infringement is charged, as set forth in said paragraph

5 (a), and at the present time, has been and is infringing said letters patent, by operating said "State" Theatre and utilizing therein the machines complained of, and that said defendant, Locust Street Real Estate Company, is the party who signed a contract for the use of said machines used in said "State" Theatre; and plaintiffs are informed and believe that each of the said three defendants are closely associated with each other and have collaborated with each other in conducting these joint and several alleged infringing acts with respect to the use of sound apparatus and methods embodying and utilizing the invention of said letters patent, and are conspiring with and aiding and abetting each other in said alleged infringements, but although plaintiffs have diligently made extensive investigations to ascertain the exact facts, they have been unable to ascertain definitely the exact relation of the said three defendants with respect to each other as to the acts of infringement complained of and the extent to which each is responsible for the acts of infringement complained of, wherefore plaintiffs pray discovery thereof.

6 (a). That said defendants have been duly notified of said Letters Patent No. 1,713,726, and of their infringement thereof in violation of plaintiffs' rights thereunder.

(b). On information and belief, that defendants have disregarded said notice and have continued after said notice and threaten to continue to infringe upon plaintiffs' rights under said letters patent.

(c). Upon information and belief, that the aforesaid acts and doings of said defendants, and their preparation to continue the same in disregard and in defiance of plaintiffs' rights, have the effect to, and do

encourage and induce others to infringe and continue to infringe upon the rights of plaintiffs under said letters patent.

7. To the end, therefore, that the plaintiffs may have such relief as they are entitled to in the premises, they pray:

(a) That a process of subpœna issue out of and under the seal of this Court, requiring each of said defendants, ~~Wilmer & Vincent Amusement Company,~~ Wilmer & Vincent Corporation, and Locust Street Real Estate Company, to appear and make full, true, correct and perfect answer to the several matters and things set forth and charged in this bill of complaint (but not under oath, an answer under oath being expressly waived).

(b). That the defendants, ~~Wilmer & Vincent Amusement Company,~~ Wilmer & Vincent Corporation, and Locust Street Real Estate Company, their officers, directors, servants, agents, confederates, and all persons, firms and corporations associated with or acting for or on behalf of said defendants or any of them, be perpetually enjoined and restrained by the decree of this Court, from directly or indirectly using, directing the use of, or causing to be used, all apparatus and/or methods embodying or employing the invention of said letters patent, and from infringing upon or contributing to the infringement of said letters patent in any manner whatsoever.

(c). That the defendants may be decreed to account for and pay over to plaintiffs all such gains, profits, and advantages as have accrued to or have been earned or received by said defendants, and all such gains, profits and advantages as would have

accrued to or been earned by the plaintiffs or either of them but for the said infringements of said defendants, and also all damages the plaintiffs, or either of them, have sustained by said infringements.

(d). That the defendants may be decreed to pay the charges, costs and disbursements of this cause, and that the plaintiffs may have such other and further relief as the premises and the equity of the case may require and to the Court may seem meet.

AMERICAN TRI-ERGON CORPORATION,
TRI-ERGON HOLDING, A. G.,
By KAUFMAN & MATTES,
*Solicitors for Plaintiffs.*

Dated at Scranton, Pa.,
October 10, 1932.

WARD, CROSBY & NEAL,
*Of Counsel,*
225 Broadway, New York, N. Y.

Dated at New York, N. Y.,
, 1932.

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Certified from the record, October 10, 1932.

S. W. HOFFORD,
*Clerk,*
Per H. M. JOHNSON,
*Deputy Clerk.*

## AMENDMENT TO BILL OF COMPLAINT.

### In Equity No. 972.

Pursuant to stipulation filed herein dated November 1, 1932, and the order of this Court based thereon, entered on November 7, 1932, plaintiffs, American Tri-Ergon Corporation and Tri-Ergon Holding, A. G., hereby amend their bill of complaint as follows:

In the caption cancel "Wilmer & Vincent Amusement Company".

Page 1* of the bill of complaint, paragraph 1 (c), cancel the matter commencing in line 1 with the words "that the defendant" down through the words "Middle District of Pennsylvania;" in line 2 of page 2.

Page 7, paragraph 5 (a), third and fourth lines in said paragraph, cancel "Wilmer & Vincent Amusement Company".

Page 9, paragraph 5 (b), cancel the entire paragraph down to paragraph 6 (a) on page 11, and insert in lieu thereof, the following:

5 (b). Upon information and belief, that with respect to said "State" Theatre and within the period during which said infringement is charged as set forth in paragraph 5 (a) supra, and at the present time, the defendant, Locust Street Real Estate Company, owned and now owns said theatre and the sound reproducing apparatus therein and complained of in said foregoing paragraph 5 (a); that said defendant instigated and directed the use of said apparatus and caused said apparatus to be used by the defendant, Wilmer & Vincent Corporation, and conspired and joined with said Wilmer & Vincent Corporation in the use of said apparatus and contributed to the use thereof, by licensing said "State" Theatre and said sound reproducing ap-

*Pages referred to in this Amendment to Bill of Complaint are to the original typewritten pages of Bill of Complaint.

paratus to the defendant, Wilmer & Vincent Corporation, for the purpose of having it operate said apparatus for the benefit of both said defendants; and that the said Wilmer & Vincent Corporation within the period during which said infringement is charged as set forth in paragraph 5 (a) supra, and at the present time, did and does operate said "State" Theatre and said sound reproducing apparatus therein and use the method complained of in the foregoing paragraph 5 (a), for the benefit of both said defendants, all in infringement of said letters patent and in defiance of plaintiffs' rights thereunder aforesaid.

Page 12, paragraph 7 (a), line 3 of said paragraph, cancel "Wilmer & Vincent Amusement Company".

Paragraph 7 (b), lines 1-2, cancel "Wilmer & Vincent Amusement Company".

AMERICAN TRI-ERGON CORPORATION,
TRI-ERGON HOLDING, A. G.,

By

By KAUFMAN & MATTES,
*Solicitors for Plaintiffs.*

Dated at Scranton, Pa.,
November , 1932.

S. MORTIMER WARD, JR.,
*Of Counsel,*
225 Broadway, New York, N. Y.
Dated at New York, N. Y.,
November 10, 1932.
Approved as to form:
CHARLES NEAVE,
per W. J. B.,
*Of Counsel for Defendants.*

## ANSWER.

The original answer in suit No. 972 was filed on February 28, 1933.

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## AMENDED ANSWER.

### In Equity No. 972.

The defendants, Wilmer & Vincent Corporation and Locust Street Real Estate Company, for answer to the amended bill of complaint herein say:

1. With respect to paragraph 1, defendants are without knowledge as to the allegations of sub-divisions (a) and (b) thereof, and defendants deny, upon information and belief, the allegations of subdivision (c), except that they admit that the defendant, Wilmer & Vincent Corporation, is a corporation of the State of Delaware, and that the defendant, Locust Street Real Estate Company, is a corporation of the State of Pennsylvania.

2. Defendants admit the allegations of paragraph 2.

3. Defendants deny, upon information and belief, each and every allegation of paragraph 3 of the amended bill of complaint, except that they admit that United States Letters Patent No. 1,713,726 were issued on May 21, 1929.

4. Defendants deny, upon information and belief, each and every allegation contained in paragraphs 4 and 5.

5. With respect to paragraph 6, defendants admit that each of them has received a notice of alleged infringement of said Letters Patent No. 1,713,726 but defendants deny, upon information and belief, each and every other allegation of said paragraph.

6. Defendants allege, upon information and belief, that the amended bill of complaint herein is defective and should be dismissed for misjoinder of parties plaintiff, because the plaintiff, Tri-Ergon Holding, A. G., does not have sufficient interest in the subject-matter of the action and in obtaining the relief demanded to be included as a party plaintiff herein, but on the contrary is an exclusive licensee in a field outside of and distinct from the field or fields in which the infringement is alleged to have occurred.

7. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void, because the patentees named therein were not the original, first and joint inventors of the alleged improvements disclosed and claimed therein, and that the same in all their material and substantial respects were known and used by others in this country before the alleged invention or discovery thereof by the said patentees; were patented and described in printed publications in this and foreign countries before the alleged invention or discovery thereof by the said patentees, and more than two years prior to the application for patent of said patentees; were in public use and on sale in this country more than two years prior to the said application for patent; were described in United States applications for patent filed in the United States Patent Office prior to the alleged invention or discovery thereof by the said patentees; were first patented or caused to be patented by the alleged inventors or their legal representatives or assigns in foreign

countries upon applications filed more than twelve months prior to the filing of the application for said Letters Patent No. 1,713,726; and were abandoned.

(a) That the patents and printed publications above referred to, in so far as they have been ascertained are as follows:

UNITED STATES PATENTS.

| | | | |
|---|---|---|---|
| 200,521 | Edison | Feb. | 19, 1878 |
| 210,249 | Gally | Nov. | 26, 1878 |
| 227,679 | Edison | May | 18, 1880 |
| 255,220 | Wale | March | 21, 1882 |
| 261,568 | Snow | July | 25, 1882 |
| 299,013 | Robb | May | 20, 1884 |
| 341,213 | Bell & Tainter | May | 4, 1886 |
| 341,214 | Bell & Tainter | May | 4, 1886 |
| 341,288 | Tainter | May | 4, 1886 |
| 364,472 | Bock | June | 7, 1887 |
| 386,974 | Edison | July | 31, 1888 |
| 423,039 | Edison | March | 11, 1890 |
| 458,916 | Oxley | Sept. | 1, 1891 |
| 464,476 | Herrington | Dec. | 1, 1891 |
| 492,898 | Westinghouse | March | 7, 1893 |
| 499,879 | Edison | June | 20, 1893 |
| 502,382 | Randall | Aug. | 1, 1893 |
| 513,095 | Edison | Jan. | 23, 1894 |
| 534,543 | Berliner | Feb. | 19, 1895 |
| 551,946 | Cooley | Dec. | 24, 1895 |
| 565,657 | Ader | Aug. | 11, 1896 |
| 587,527 | Holst | Aug. | 3, 1897 |
| 597,875 | Clark | Jan. | 25, 1898 |
| 602,453 | Jones | Apr. | 19, 1898 |
| 605,484 | Jones | June | 14, 1898 |
| 691,667 | Rowland | Jan. | 21, 1902 |
| 707,389 | Churchward | Aug. | 19, 1902 |
| 724,645 | Wood | Apr. | 7, 1903 |

| | | |
|---|---|---|
| 773,985 | Ries | Nov. 1, 1904 |
| 867,682 | Spaulding | Oct. 8, 1907 |
| 902,586 | Lanza | Nov. 3, 1908 |
| 930,605 | Moore | Aug. 10, 1909 |
| 939,692 | Holman | Nov. 9, 1909 |
| 995,390 | Underhill | June 13, 1911 |
| 1,065,576 | Amet | June 24, 1913 |
| 1,075,692 | Cannock | Oct. 14, 1913 |
| 1,085,392 | Van Riper | Jan. 27, 1914 |
| 1,085,443 | Lanchester | Jan. 27, 1914 |
| 1,115,728 | Norton | Nov. 3, 1914 |
| 1,135,436 | Chabeault | Apr. 13, 1915 |
| 1,162,433 | Amet | Nov. 30, 1915 |
| 1,165,629 | Schneider | Dec. 28, 1915 |
| 1,175,205 | Turner et al. | March 14, 1916 |
| 1,185,056 | Byron | May 30, 1916 |
| 1,186,069 | Blair | June 6, 1916 |
| 1,186,982 | Hall | June 13, 1916 |
| 1,203,190 | Fritts | Oct. 31, 1916 |
| 1,221,407 | Amet | Apr. 3, 1917 |
| 1,246,217 | Andersen | Nov. 13, 1917 |
| 1,255,143 | Ebeling | Feb. 5, 1918 |
| 1,258,226 | Camowski | March 5, 1918 |
| 1,256,613 | Terwilliger | Feb. 19, 1918 |
| 1,261,797 | Ebeling | Apr. 9, 1918 |
| 1,273,328 | Cameron | July 23, 1918 |
| 1,273,627 | Langmuir | July 23, 1918 |
| 1,286,527 | Burton et al. | Dec. 3, 1918 |
| 1,292,448 | Emory | Jan. 28, 1919 |
| 1,317,450 | Momyer | Sept. 30, 1919 |
| 1,346,755 | Lanchester | July 13, 1920 |
| 1,355,523 | Arthur | Oct. 12, 1920 |
| 1,366,446 | Collins | Jan. 25, 1921 |
| 1,367,863 | Clark | Feb. 8, 1921 |
| 1,372,619 | Hoestetter | March 22, 1921 |
| 1,381,474 | Kunz | June 14, 1921 |

| | | | |
|---|---|---|---|
| 1,388,515 | Clark | Aug. | 23, 1921 |
| 1,425,177 | Constable | Aug. | 8, 1922 |
| 1,447,913 | Trowbridge, et al. | March | 6, 1923 |
| 1,449,327 | Jaycox et al. | March | 20, 1923 |
| 1,473,976 | Ries | Nov. | 13, 1923 |
| 1,567,424 | Compton | Dec. | 29, 1925 |
| 1,594,662 | Cawley | Aug. | 3, 1926 |
| 1,607,480 | Ries | Nov. | 16. 1926 |
| 1,710,677 | Cawley | Apr. | 23, 1929 |
| 1,825,438 | Cawley | Sept. | 29, 1931 |
| 1,825,439 | Cawley | Sept. | 29, 1931 |
| 1,825,440 | Cawley | Sept. | 29, 1931 |
| 1,825,441 | Cawley | Sept. | 29, 1931 |
| 1,878,577 | Cawley | Sept | 20, 1932 |

FOREIGN PATENTS.

BRITISH.

| | | |
|---|---|---|
| 1,644 | Edison | of 1878 |
| 2,814 | Jamieson et al. | of 1884 |
| 21,371 | Baron | of 1898 |
| 24,546 | Duddell | of 1902 |
| 3,701 | Polyphos | of 1908 |
| 5,029 | | of 1911 |
| 15,3[illegible] | | of 1912 |
| 115,9[illegible] | [illegible]en | of 1918 |
| 157,43 | [illegible] et al. | Applied for in 1921 |

FRENCH.

| | | |
|---|---|---|
| 319,425 | Buss | 1902 |
| 393,301 | Fabbrica etc. Parlate | 1908 |
| 10,377 | Fabbrica etc. Parlate | 1909 |
| 414,788 | Comp. Gen. de Phon. | 1910 |
| 416,838 | Martinez | 1910 |
| 472,467 | Dragoumis | 1914 |
| 532,172 | Vogt et al. | Applied for in 1921 |

GERMAN.

| | | |
|---|---|---|
| 363,640 | Aftergut | 1922 |
| 387,058 | Vogt et al. | Applied for in 1920 |
| 417,967 | Vogt et al. | Applied for in 1919 |

SWISS.

| | | |
|---|---|---|
| 85,751 | Alber | 1920 |

SWEDISH.

| | | |
|---|---|---|
| 64,802 | Vogt et al. | Applied for Dec. 31 1920 |

NORWEGIAN

| | | |
|---|---|---|
| 36,326 | Vogt et al. | Applied for Dec. 30 1920 |

PUBLICATIONS.

Scientific American Supplement No. 133, July 20, 1878, pages 2112 and 2113.

Scientific American, June 18, 1881, page 394.

La Nature No. 1266, September 4, 1897, pages 209 to 211, inc.

La Nature No. 1288, February 5, 1898, page 158.

The Electric Journal, Vol. XI, No. 5, May, 1914, pages 262 and 263.

Physical Review, Vol. 10, No. 2, August, 1917, pages 205 and 206.

Proceedings of the Physical Society, Vol. XXXII, 1920, pages 78 to 81, inc.

(b) That the instances of prior invention, knowledge, use and sale above referred to in so far as they have been ascertained are as follows:

By the patentees of the patents and by the authors of the publications in subdivision (a)

above at the places therein stated and elsewhere in the United States.

By Eugene Lauste of Bloomfield, New Jersey at Bloomfield, New Jersey and elsewhere in the United States.

By Delmar A. Whitson of Los Angeles, California at Los Angeles, California and elsewhere in the United States.

By Alfred E. Oswald of Hackensack, New Jersey at Bogota, California and elsewhere in the United States.

By Alfred C. Clark of New York, New York at New York, New York and elsewhere in the United States.

By Emile Berliner, of Washington, D. C., at Washington, D. C., and elsewhere in the United States.

By William M. Clark, of South Orange, New Jersey, at South Orange, New Jersey, and elsewhere in the United States.

By Anthony J. Weber, of Bloomfield, New Jersey, at Orange, New Jersey, New York, New York, and elsewhere in the United States.

By George K. Thompson, of Maplewood, New Jersey, at New York, New York, and elsewhere in the United States.

By Edison Phonograph Company, of Orange, New Jersey, at Orange, New Jersey, and elsewhere in the United States.

By Thomas A. Edison, Inc., of Orange, New Jersey, at Orange, New Jersey, and elsewhere in the United States.

By Victor Talking Machine Company, of Camden, New Jersey, at Camden, New Jersey, and elsewhere in the United States.

By Underwood Typewriter Company, of New York, New York, at New York, New York, and elsewhere in the United States.

By American Telephone & Telegraph Company, of New York, New York, at New York, New York, and elsewhere in the United States.

By Western Electric Company, Incorporated, of New York, New York, at New York, New York, and elsewhere in the United States.

By General Electric Sompany, of New York, New York, at Schenectady, New York, and elsewhere in the United States.

By Nicholas Power Company, of New York, New York, at New York, New York, and elsewhere in the United States.

By Precision Machine Company, of York, New York at New York, New York, and elsewhere in the United States.

By Bergmann & Company, of New York, New York, at New York, New York, and elsewhere in the United States.

By Advertising Record Corporation, of New York, New York, at New York, New York, and elsewhere in the United States.

By Talking Book Corporation, of New York, New York, at New York, New York, and elsewhere in the United States.

By Columbia Phonograph Company, of Bridgeport, Connecticut, at Bridgeport, Connecticut, and elsewhere in the United States.

By Smithsonian Institute, United States National Museum, of Washington, D. C., at Washington, D. C., and elsewhere in the United States.

(c) That the applications for patents above referred to, in so far as they have been ascertained are as follows:

The applications for Letters Patent of the United States listed in subdivision (a) above.

(d) That the above referred to foreign patents obtained by the alleged inventors or their legal representatives or assigns, in so far as they have been ascertained are as follows: German Patent No. 387,058 for which the application was filed in Germany on May 23, 1920; German Patent No. 417,967 for which the application was filed in Germany on March 4, 1919; British Patent No. 157,433 for which the application was filed in Great Britain on January 10, 1921; French Patent No. 532,172 for which the application was filed in France on March 15, 1921; Swedish Patent No. 64,802 for which the application was filed in Sweden on December 31, 1920; Norwegian Patent No. 36,326 for which the application was filed in Norway on December 30, 1920; Italian Patent corresponding to German Patent No. 417,967 for which the application was filed in Italy on January 29, 1921; Belgian patent corresponding to German Patent No. 417,967 for which the application was filed in Belgium on December 24, 1920.

8. Defendants allege, upon information and belief, that by reason of the proceedings in the United States Patent Office during the prosecution of the application which resulted in said Letters Patent No. 1,713,726, and the admissions and representations therein made by or in behalf of the alleged inventors in order to induce the grant of the said letters patent, the plaintiffs are estopped to claim for said letters patent a construction, were the same otherwise possible, as would cause said letters patent to cover or include any machine or device manufactured, used or sold by the defendants.

9. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid

and void because the alleged improvements described and claimed therein did not constitute patentable subject-matter within the meaning of the patent laws, in view of the prior state of the art and what was common knowledge on the part of those skilled in the art; all prior to the date of the alleged invention thereof by the patentees named therein.

10. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void, or cannot be given a valid interpretation which would bring any devices or acts of the defendants within the scope thereof, because the alleged invention described and claimed in said letters patent was not described or claimed in the original application as filed, upon which said letters patent were granted, but on the contrary constitutes new matter illegally and unjustifiably added to the said application subsequent to the filing thereof.

11. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the alleged invention described and claimed therein is inoperative and incapable of producing any new or useful result.

12. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the alleged invention is not described therein in such full, clear and exact terms as to enable any person skilled in the art or science to which it appertains to make, construct or use the same.

13. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and void because the specification and claims thereof are indefinite, ambiguous and uncertain and do not par-

ticularly point out and distinctly claim the alleged invention or discovery.

14. Defendants allege, upon information and belief, that said Letters Patent No. 1,713,726 are invalid and unenforcible because of intervening rights arising prior to the issuance of said letters patent.

WHEREFORE, the defendants pray that the amended bill of complaint herein be dismissed with costs to the defendants.

WILMER & VINCENT CORPORATION and LOCUST STREET REAL ESTATE COMPANY,

By (Sgd.) CHARLES NEAVE,
By H. R. A.
*Counsel for Defendants.*

May 11, 1933.

REESE H. HARRIS,
*Solicitor for Defendants.*

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**ORDER AMENDING ANSWERS.**

**(In Both Suits.)**

It is ordered that the amended answers in the above-entitled suits be and the same are hereby amended by adding to the list of German patents in paragraphs 7 (a) the following:

German Patent No. 141,634 of 1903 to Elias Kher.

(Sgd.) ALBERT W. JOHNSON,
*United States District Judge.*

June 22, 1933.

Consented to:

S. MORTIMER WARD,
*Counsel for Plaintiffs.*

## STATEMENT OF EVIDENCE.

MR. WARD: First I offer in evidence certified copy of the file wrapper and contents of the patent in suit, including a copy of the patent in suit, and ask that it be marked Plaintiffs' Exhibit No. 1.

(Received in evidence and marked Plaintiffs' Exhibit 1.)

MR. WARD: I offer in evidence a book of the patent references cited in the prosecution of that application, and ask that the same be marked in evidence as Plaintiffs' Exhibit 1-A.

(Received in evidence and marked Plaintiffs' Exhibit 1-A.)

MR. WARD: I offer in evidence certified copy of the disclaimer of the patent in suit, and ask that it be marked Plaintiffs' Exhibit 2.

(Received in evidence and marked Plaintiffs' Exhibit 2.)

MR. WARD: I offer in evidence certified copy of German application and translation, filed May 22d, 1920, of Vogt, et al., and ask that the same be marked Plaintiffs' Exhibit 3.

(Received in evidence and marked Plaintiffs' Exhibit 3.)

MR. WARD: I offer in evidence certified copy of Vogt, et al., German application, a translation thereof, application filed March 24th, 1921, and ask that the same be marked Plaintiffs' Exhibit 4.

(Received in evidence and marked Plaintiffs' Exhibit 4.)

MR. WARD: I offer in evidence certified copy of Vogt German application and translation, application

filed April 9th, 1921, and ask that it be marked Plaintiffs' Exhibit 5.

(Received in evidence and marked Plaintiffs' Exhibit 5.)

MR. WARD: I offer in evidence certified copy of Vogt German application with translation as filed, the application being dated January 23d, 1922, and ask that the same be marked Plaintiffs' Exhibit 6.

(Received in evidence and marked Plaintiffs' Exhibit 6.)

MR. WARD: I offer in evidence Vogt, et al., United States Patent No. 1,590,185, being the patent referred to in the patent in suit, and ask that it be marked Plaintiffs' Exhibit 7.

(Received in evidence and marked Plaintiffs' Exhibit 7.)

MR. WARD: I offer in evidence certified copy of file wrapper and contents of the Vogt, et al., United States application Serial No. 458,626, filed April 4th, 1921, and ask that it be marked Plaintiffs' Exhibit 8.

(Received in evidence and marked Plaintiffs' Exhibit 8.)

MR. WARD: I offer in evidence certified copy and translation of the Vogt German application of March 3d, 1919, this being the German application on which the preceding United States application, Exhibit 8, was predicated, and ask that it be marked Exhibit 9.

(Received in evidence and marked Plaintiffs' Exhibit 9.)

MR. WARD: I offer in evidence certified copy of the decision of Judge Adkins, of the Supreme Court of the District of Columbia, in connection with Exhibit 8, and ask that it be marked Plaintiffs' Exhibit 10.

(Received in evidence and marked Plaintiffs' Exhibit 10.)

MR. WARD: I offer in evidence copy and translation of Vogt, et al., Belgium patent with translation, No. 292,863, being one of the early issued patents of these patentees for the photoelectric cell. United States application being still pending. And I ask that that be marked Plaintiffs' Exhibit No. 11.

(Received in evidence and marked Plaintiffs' Exhibit 11.)

MR. WARD: I offer in evidence copy of the Vogt, et al., French Patent No. 532,651, published February 9th, 1922, relating to photoelectric cell connections, with translation, and ask that it be marked Plaintiffs' Exhibit 12.

(Received in evidence and marked Plaintiffs' Exhibit 12.)

MR. WARD: I offer in evidence a copy of the German application of Vogt, et al., dated April 16th, 1919, corresponding in part to the French patent Exhibit 12, with translation, and ask that the same be marked Plaintiffs' Exhibit 12-A.

(Received in evidence and marked Plaintiffs' Exhibit 12-A.)

MR. WARD: I offer in evidence correspondence between our office, Ward, Crosby & Smith, and Ward, Crosby & Neal, and Mr. Neave's office, and the R. C. A., in connection with their having these inventions and applications and the subject matter brought to their attention in the year 1925, including notice of infringement, and including letters stating that they were not interested in the commercial use of the subject matter until 1928, and including a letter offering to take a license under the patent. I ask that this correspondence be marked Plaintiffs' Exhibit 13.

MR. NEAVE: I have no objection to those, in so far as he is putting in copies and so forth instead of the originals. Some of those letters represent correspondence which took place after notice of infringement in this case, and I think they represent negotiations for settlement. This last thing he spoke of, about offering to take a license—that is not quite exact. But I may say also that it was after the suit was brought. Of course, if they would have given us a license for five dollars, we would have taken it and not bothered with the suit. That correspondence, I submit, has no probative force at all, and therefore I object to that portion of the correspondence which took place after notice of infringement.

MR. WARD: Your Honor, I do not think that this relates to matters of settlement at all. This letter from Mr. Adams seems to us to be an admission on their part that they were not interested in commercial work along this line until after 1928, although these inventions were submitted to them, and they studied them since 1925. This other letter that Mr. Neave is objecting to is as follows; it is dated January 31st, 1931, addressed to me, and is as follows:

> "I understand that the Radio Corporation or one of its subsidiaries is considering the manufacture or use of certain apparatus, in which some of the features purported to be covered by the Vogt Patent No. 1,713,726, might be employed. A license under reasonable terms may be desired."

The letter goes on to suggest an interview with Mr. Otto Schairer, one of the vice-presidents of the Radio Corporation——

MR. NEAVE: That is what I objected to.

MR. WARD: For whatever it is worth, I think your Honor should have it before you. Now, the other

letter that he objects to is a letter from Mr. Schairer to me of February 26th, 1931, which reads:

"Referring to our discussion of a few days ago with regard to the Vogt et al. patent——"

MR. NEAVE: Not to take up the time, might I suggest that the ruling upon my motion be deferred?

THE COURT: That is what I was going to do. I was going to receive the offer, subject to your objection. And when the Court comes to consider the whole case, we will have to necessarily, consider the admissibility and applicability of all of the evidence. So that, with that understanding, I will receive the evidence subject to your objection and unless in this case the evidence is clearly out of the line I will follow the same policy as to both sides.

MR. WARD: The correspondence also includes a letter from Mr. Schroeder, who was the representative of the Tri-Ergon people over here at that time, to Mr. David Sarnoff, vice-president of the Radio Corporation, and a letter to Mr. Schroeder from Mr. Adams. I will not stop to give the dates of these letters. They are all together. We have given the defendants copies of that correspondence some time ago, to check up.

(Received in evidence and marked Plaintiffs' Exhibit 13.)

MR. WARD: As to the title, I offer the following papers in evidence:

Certified copy of assignment filed in the United States Patent Office, from Vogt et al., to Tri-Ergon, Ltd. (otherwise known as Tri-Ergon A. G.), dated June 3d, 1924, including the application for the patent in suit, designated there as Serial No. 545,377, and ask that it be marked Plaintiffs' Exhibit 14-A.

(Received in evidence and marked Plaintiffs' Exhibit 14-A.)

Mr. Ward: I offer in evidence photostat of agreement and assignment between Tri-Ergon A. G. and William Fox, dated September 4th, 1928, with attached schedule A of the United States Patents and applications, referring to the application of the patent in suit by the serial number above mentioned, and an attached copy of license in German, from Tri-Ergon A. G. to Tri-Ergon Music A. G., said license having attached thereto lists of foreign and United States patents and applications, the application of the patent in suit being referred to by Serial No. 545,377, and by the unofficial designation A23a, and I ask that it be marked Plaintiffs' Exhibit 14-B.

(Received in evidence and marked Plaintiffs' Exhibit 14-B.)

Mr. Ward: I offer in evidence next translation of license to Tri-Ergon Music A. G., and ask that it be marked as Plaintiffs' Exhibit C.

(Received in evidence and marked Plaintiffs' Exhibit 14-C.)

Mr. Ward: I next offer in evidence photostat of assignment from Tri-Ergon A. G., to William Fox, dated February 15th, 1929, and recorded in the United States Patent Office, and referring to the application of the patent in suit by Serial No. 545,377, and ask that the same be marked Plaintiffs' Exhibit 14-D.

(Received in evidence and marked Plaintiffs' Exhibit 14-D.)

Mr. Ward: I offer in evidence photostat of assignment from William Fox to American Tri-Ergon Corporation, dated June 6th, 1930, and referring to the patent in suit by number, and ask that it be marked in evidence as Plaintiffs' Exhibit 14-E.

(Received in evidence and marked Plaintiffs' Exhibit 14-E.)

MR. WARD: I next offer in evidence photostat of the agreement between Tri-Ergon Music A. G., and Tri-Ergon Holding A. G., dated November 10th, 1931, transferring rights under Tri-Ergon Music A. G., license, to Tri-Ergon Holding A. G., and including photostat in German of license from Tri-Ergon Music A. G. to Allgemeine Elektricitats-Gesellschaft, said license applying to countries outside of North America, with attached translation of said license, and ask that it be marked Plaintiffs' Exhibit 14-F.

(Received in evidence and marked Plaintiffs' Exhibit 14-F.)

MR. WARD: I next offer in evidence photostat of agreement between Tri-Ergon A. G. and Tri-Ergon Holding A. G., dated November 10th, 1931, transferring interest of Tri-Ergon A. G. in said Musik Company license to Tri-Ergon Holding A. G., and ask that it be marked Plaintiffs' Exhibit 14-G.

(Received in evidence and marked Plaintiffs' Exhibit 14-G.)

MR. WARD: I offer in evidence general stipulation entitled in both suits, covering various matters.

The attached drawings showing the defendants' machines can be marked as exhibits attached to the stipulation. The stipulation will be marked Plaintiffs' Exhibit 15, and the attached drawings respectively 15-A, 15-B, 15-C, 15-D, 15-E and 15-F.

(Stipulation of counsel covering various formal matters in both suits, received in evidence and marked Plaintiffs' Exhibit 15.)

(Drawings attached to stipulation, received in evidence and marked respectively Plaintiffs' Exhibits 15-A, 15-B, 15-C, 15-D, 15-E and 15-F.)

The stipulation, Plaintiffs' Exhibit 15, is as follows:

It Is Hereby Stipulated and agreed by and between counsel for the respective parties, for the purpose of the above entitled suits only—

1. That these two suits shall be tried, briefed and argued together as one suit.

2. That plaintiff, American Tri-Ergon Corporation, is a corporation of the State of New York, incorporated April 28, 1928, having its place of business in the Borough of Manhattan, County and State of New York, and that the plaintiff, Tri-Ergon Holding, A. G., is a corporation of Switzerland, having its place of business at St. Gall., Switzerland.

3. That the citizenship and residences of the applicants, Hans Vogt, Joseph Massolle and Josef Engl, are as pleaded in the amended bills of complaint herein.

4. That so far as concerns the objection that copies are offered in lieu of originals and subject to correction should error appear, defendant will not object to the admission in evidence of photostatic copies of the same alleged assignments and agreements referred to in paragraphs 3b, 3c, 3d, 3f, 3g, and 3h of the amended bills of complaint, nor to copies of any such alleged assignments certified by the Commissioner of Patents as being true copies of assignments as recorded in the United States Patent Office, nor to a photostatic copy of a certain agreement between Tri-Ergon A. G., of Zurich, Switzerland, and Tri-Ergon Musik A. G. of St. Gall., Switzerland, dated November 8, 1926, and November 15, 1926; and such copies shall have the same force and effect as the orig-

inals duly proved; but defendant reserves the right to object to their admission on any other ground or for any other reason.

5. That Dr. Adolf Blatter, president of Tri-Ergon A. G., if called as a witness on behalf of plaintiffs, would testify that the corporation, variously referred to in one or more of the papers relating to the title of the patent in suit as "Tri-Ergon, Limited", and "Tri-Ergon, A. G." is one and the same corporation, the name of which is "Tri-Ergon A. G.," and that this stipulation shall be given the same force and effect as if the same Adolf Blatter were called as a witness and testified as above stated.

6. Reserving the right to object to the admission in evidence of United States and foreign patents, and publications on any other ground or for any other reason than that copies are offered instead of originals, it is stipulated:

(a) that printed or photostatic copies of United States and foreign patents may be introduced in evidence at the trial in lieu of the originals or certified copies thereof, with the same force and effect as the originals duly proved, and the dates appearing thereon shall be accepted as correct subject to correction should error appear, excepting it shall not be presumed under this stipulation that the disclosure in any patent as granted is the same as the disclosure in the application for said patent as filed or the same as the disclosure in any application of which said patent application is claimed to be a division or a continuation; and

(b) that photostatic copies of printed publications may be introduced in evidence at the trial in lieu

of originals thereof, with the same force and effect as originals thereof duly proved, and the dates of publication appearing thereon shall be accepted as correct, subject to correction should error appear.

7. Subject to correction should error appear, that true copies of any applications for foreign patents based upon alleged inventions of Hans Vogt, Joseph Massolle and Josef Engl, and true copies of any and all proceedings in foreign Patent Offices and in foreign courts in connection with any such foreign applications or patents granted thereon may be accepted in evidence with the same force and effect as originals duly proved, including the date of filing of any such application and the date of any such proceedings, but both parties reserve the right to object to the admission of such true copies as may be offered by the other party on any ground or for any reason that objection might be made to the duly proved originals thereof.

8. Subject to correction if error should appear, that any application for United States or foreign letters patent applied for in the name of Vogt, Massolle and Engl (in whatever order the three names may be stated) and as to any patents granted to them or granted to others upon any such applications, the applicants for any such application shall be presumed to be the same Vogt, Massolle and Engl as the applicants for the patents in suit.

9. That prior in 1919 Germany was and ever since has been a "convention" country with respect to R. S. 4887, and its citizens since prior to 1919 have been entitled to the privileges of said statute.

10. That the three drawings initialed by defendants' counsel and marked, respectively,

(A) Diagram of defendants' PS 1 sound apparatus (containing Fig. 1),

(B) Diagram of details of defendants' PS 1 sound apparatus (containing Figs. 2, 3, 4 and 5),

(C) Details of defendants' PS 1 sound apparatus (containing Figs. 6, 7, 8 and 9)—

for the purpose of this suit correctly show in diagrammatic form the sound-reproducing apparatus in the State Theatre in Harrisburg, Pa., with respect to which defendants in suit No. 972 are charged with infringement. The descriptive printed matter appearing on the said drawings is not stipulated.

That subsequent to the grant of the patent in suit and prior to the filing of the bill of complaint in suit No. 972, the said theatre and apparatus were operated by the defendant, Wilmer & Vincent Corporation, and said theatre was owned by and said apparatus leased by the defendant, Locust Street Real Estate Company.

11. That the three drawings initialed by defendant's counsel and marked, respectively,—

(A′) Diagram of defendants' PS 16 sound apparatus containing Fig. 1,

(B′) Diagram of details of defendants' PS 16 sound apparatus containing Figs. 2′, 3′, 4′ and 5′,

(C′) Diagram of details of defendants' PS 16 sound apparatus containing Figs. 6′, 7′ and 8′,

for the purpose of this suit correctly show in diagrammatic form the sound-reproducing apparatus in the Grand Theatre at Huntingdon, Pa., with respect to which the defendant in suit No. 971 is charged with infringement. The descriptive printed matter appearing on the said drawings is not stipulated.

That subsequent to the grant of the patent in suit and prior to the filing of the bill of complaint in suit No. 971, said theatre and said apparatus was leased and operated by said defendant.

12. That during said period said machines were used for reproducing sound motion pictures from film containing sound and picture records, the sound record being arranged alongside of the pictures between the same and one of the rows of sprocket perforations in the film; that the sound records used on the film were of two types, (1) the variable density type as illustrated by a strip of sound picture film marked "D" for identification, and (2) the variable area type as illustrated by a strip of sound picture film marked "E" for identification; that in reproducing the sound and projecting pictures from the film, the film passed through the machine at the rate of approximately ninety feet per minute.

13. Defendants state that the dimensions of the beam of light at the film in both types of machines shown in the two sets of drawings were approximately .084 of an inch in length and .001 of an inch in width and that the corresponding dimensions of the slits used in the optical systems of both types of machines were greater than the above dimensions.

14. That this suit is being openly defended by Radio Corporation of America on behalf of its wholly owned subsidiary R. C. A. Photophone, Inc. R. C. A. Photophone, Inc., leased the apparatus charged with infringement to the defendant, Altoona Publix Theatres, Inc., and to the defendant, Locust Street Real Estate Company, respectively.

15. That the privileges accorded by the Nolan Act of March 3, 1921 (41 St. L. 1313) were on or about October 21, 1921, extended to citizens of Germany.

S. Mortimer Ward, Jr.,
*Counsel for Plaintiffs.*
Charles Neave, H. R. A.,
*Counsel for Defendants.*

June 5, 1933.

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Mr. Ward: I offer in evidence large charts which are enlargements respectively of the Exhibits 15-A to 15-F, with certain parts colored, and ask that they be marked Plaintiffs' Exhibits 16-A to 16-F respectively.

(Received in evidence and marked respectively Plaintiffs' Exhibits 16-A to 16-F inclusive.)

Mr. Ward: The plaintiff as to the first suit involving the defendants' machine, involving PS1, is relying upon claims 5, 7, 9, 13, 18, and 19. As to the second suit, involving the defendants' machine PS16, the plaintiffs are relying upon claims 9, 13, 17, 18, and 19.

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DR. FREDERICK HOLBORN, called as a witness in behalf of the complainants, being first duly sworn, testified as follows:

Direct Examination.

By Mr. Ward:

My name is Frederick Holborn; forty years of age; living at 15 Eastwood Avenue, Cedarhurst, New Jersey. My occupation is research engineer. I took the degree of doctor of philosophy at the University of Jena in Germany in 1921. At that time I was employed by the engineering department of the German Post Office, working on problems of radio transmission and

amplifying tubes. I stayed with the German Post Office until May, 1922, and left them in May, 1922, and joined a laboratory which Dr. DeForest had at that time in Berlin. I was with DeForest in Berlin until December, 1922, after joining him in May, 1922. That is, Dr. DeForest left about in September, 1922, and I was alone in the laboratory—I was in charge of the laboratory from September until December.

Dr. DeForest was working on the development of a talking film while I was with him in that laboratory, with sound recorded on films. I saw his work and I helped him occasionally in the work, my own work being on vacuum tubes. My connection with DeForest was in vacuum tube amplifiers, that end of the work.

Prior to seeing or hearing any demonstrations of sound on film sound pictures by DeForest in this laboratory which I went into in May, 1922, I saw two demonstrations of sound on film and sound pictures before that. Both demonstrations were in Berlin. The first was given in the laboratory of Messrs. Masolle, Vogt and Engl, and it was a private demonstration given to members of the post office research and engineering staff. It was in the southeast of Berlin, I think in the Coepernicker Strasse, in the laboratory of the three men named above. That first demonstration was either late in 1921 or early in 1922. I was still connected at that time with the German Post Office.

I recall some of the people who were at that demonstration. There were two representatives of the Lorenz Company of Berlin, one of their directors, Mr. Held, and one of their engineers, Mr. Scheptmann, and I recall members of the invited telegraph engineers, who were present at that time. I saw the three parties, Engl, Masolle and Vogt at that demonstration. All three of them were present and gave a short technical explanation of their process. They reproduced several

short talking films. I believe the first one was a speech given by Mr. Massolle, explaining the technical basis of their invention in a general way, and after that a dialogue, and I think a string quartette. It consisted of music and speech.

The quality was very good. It compared very favorably with what you hear in the average theatre nowadays.

Dr. Engl, I believe, explained that an electric glow tube was used for recording, and a photo cell connected with amplifying tubes and an electrostatic loud speaker for reproducing, and we had an opportunity of seeing several of those loud speakers in the laboratory after the demonstration. In leaving the laboratory we filed around the projecting and reproducing machine and had an opportunity to see the film on the sprocket wheel, and I remember that the sprocket wheel was hollow, and inside was what I believe was the photo-electric cell, and the sound record was plainly visible overhanging the sprocket wheel; in other words, the sound record was outside of the two rows of perforations of the film. The light went through the sound record at that point.

**Q. 24. In your previous answer you said you believed Dr. Engl said something to you. By your use of the word "believe," was your doubt with regard to whether it was Dr. Engl or somebody else, or with regard to what was told you?**

**A. No. It was with regard to who told it to us.**

**I had occasion to examine the machine with respect to further constructions as to how that film was controlled in its passage through the machine.**

**Connected to the shaft which carried the hollow sprocket roller, there was a flywheel connected outside of the projecting machine. That is, the flywheel was on the shaft, and that went through that hollow sprocket.**

Mr. Vogt explained the loud speaker in detail. He had several loud speakers that were taken apart, and the different components of the loud speakers were shown to us after the demonstration. I would call the loud speaker a large condenser loud speaker or electrostatic loud speaker.

As I recall it, they explained the advantages of an optical instead of a mechanical slit.

I remember that they used tubes with more than one grid in the amplifier. They had double or triple grid tubes, multiple grid tubes.

After seeing that first demonstration, I saw another demonstration given by these people, Engl, Massolle and Vogt, in Berlin before I left Berlin in January, 1923. I think it was in the late fall of 1922 in the Urania Theatre. I know that we had tickets, and I think we paid for them. The quality was good, and the speech and music that were reproduced could be plainly heard in the theatre.

Reverting for a moment to the first demonstration, I recall some special tests being made to demonstrate or show the efficiency of the amplifier system. Somebody spoke into a microphone which was connected to the amplifying system, and which was put in one of the outside rooms, and in order to show that the high frequencies of the speech were well transmitted, he whispered, and I distinctly recall what impression that made upon the audience, because all these rather high frequency whispered sounds were all truly reproduced in the amplifying system. That was not the audience consisting of the engineers in the 1921 demonstration. That was not in the Urania.

I had occasion to observe the quality of sound reproduction of Dr. DeForest in his laboratory after I went with him in 1922 in Berlin.

Q. 39. Will you please state what was the quality of that sound reproduction as compared with that

which you witnessed given by the Tri-Ergon inventors, Vogt, Engl and Massolle?

MR. NEAVE: I object to that, your Honor. Whether DeForest made anything that was better or worse than these people, Engl and so forth, cannot make any possible difference here.

MR. WARD: This man worked with Dr. DeForest. Dr. DeForest is one of the leading scientists of the world. The R. C. A. is one of the licensees under some of his inventions. They claim that the application of the flywheel in this particular connection is a perfectly obvious thing. Dr. DeForest did not use a flywheel for some months or years after he started developing this thing, and because he did not use it, one of the principal factors of his not using it was that his sound reproduction was not good. This witness was present with him. He will testify that he did not use a flywheel, and that the results were very poor, as compared to the results of the German inventors. I submit it is a very important fact in the case in connection with their contention that this was an obvious thing, because the courts have said that the real test of invention or validity is not, as Judge Hough expressed it, "picking on the rag heap of paper patents," but an examination into what the actual workers of the art, the men actually trying to accomplish these things, what they did, and what was their reaction.

THE COURT: I will receive it subject to your objection.

A. It was rather poor, compared to the quality of the Tri-Ergon reproduction.

Dr. DeForest, while he was in Berlin, did not use a flywheel in his machine for the sound head. I was

familiar with his machine from May, 1922, until September, I would say, because his apparatus was packed in September and sent back to America.

After I came to America in 1923, I was connected with the DeForest Radio Telephone & Telegraph Company. I saw two demonstrations given by Dr. DeForest in America, both in 1923, in New York City. One was a demonstration in the auditorium of the Engineering Building in 39th Street, and the other one was a regular feature for, I think, a week or two at the Rialto Theatre on Broadway in New York City.

Both of the DeForest demonstrations in New York in 1923 were not as good as the Tri-Ergon demonstrations in 1922 in Berlin.

This photograph shows a standard motion-picture projector with additions of amplifiers for the talking films.

I think it is this type that we saw at the first demonstration in Berlin which I mentioned to you.

(Photograph of standard motion picture projector with additions of amplifiers, marked Plaintiffs' Exhibit 17 for identification.)

The Tri-Ergon inventors, Vogt, et al., at the first or laboratory demonstration that I witnessed, explained the purpose for which they used the static loud speaker as to its effect on frequency.

They stated the advantages of the electrostatic speaker, especially of their type, which had a very thin and tightly stretched mica diaphragm, which was silvered on one side for the conformed reproductions of the high frequencies; in other words, they stressed the importance of having the natural frequency of the loud speaker diaphragm higher than any frequency that they wanted to reproduce.

CROSS-EXAMINATION.

By MR. NEAVE:

Referring to this photograph that has been marked Plaintiffs' Exhibit for identification No. 17, I think it represents a piece of apparatus I saw in operation. I am not sure whether it was that identical machine, but it was of that general type. I never did any work on that machine. I did not take it to pieces.

When I was working in the radio transmission work of the German post office, I had nothing to do with movies or talking movies. And when I was with DeForest my branch of the work was on vacuum tubes.

Occasionally I helped him with his work. Such as rebuilding an amplifier for him and making tubes for this amplifier in my tube laboratory, or speaking for the purpose of recording German speech on the film, or occasionally playing the violin for the purpose of recording.

As to whether I was an expert on sound or sound reproducing apparatus, I got a fairly good musical training, so I might say that I might qualify as a sound expert in those days. Which is probably different from the sound expert now.

I went to the exhibition in the laboratory of Massolle, Vogt and Engl merely because I was invited as one of the German post office employees. And I had nothing to do with the construction or operation of the apparatus that was there. I had nothing to do with the construction of the apparatus that DeForest used for recording or reproducing. As to how I happened to go to the exhibition in the fall of 1922—in the Urania Theatre—I recall that that was advertised in the papers.

And when I went to the exhibition in the laboratory late in 1921 or early in 1922, that was the first sound on film reproduction I had ever heard. That

was sound and pictures. As to whether that was the first sound and picture performance that I had ever been to, I recall in my early youth I saw the so-called Biophone of Edison in Berlin, which, as I recall it, was a synchronized gramophone and ordinary motion picture. That was a film motion picture. I do not think it was very satisfactory, because the synchronism was not always perfect. I don't think I can fix the date. I would say at least as early as 1905, but I don't think I could state it precisely.

The synchronization was not very good there, that is, the synchronization between the sound and the moving picture. The sound quality was squawky, but just as intelligible as the early phonograph. From 1905 to late in 1921 or early in 1922 I did not hear any talking movies at all. I would not say that anything that would talk at all was rather a novelty to me at that time, because we were doing considerable work on telephone repeaters at the German post office at that time, so we knew about what good speech reproduction and also music reproduction was. The reproduction that I heard in the laboratory was both speech and music. The amplifying effect of the speech reproduction that I heard in the laboratory and later in 1922 in the Urania Theatre was good. As to what is my standard of "good," well, I call a good reproduction of music, one where I can recognize any musical instrument without seeing it being played.

It is not true that the vocal numbers of those exhibitions often caused an impression upon the ear that was painful. The human speech was entirely intelligible.

The DeForest apparatus that I said I heard operate was not as good as what I heard at the laboratory or at the Urania Theatre. The music evidently suffered from cut-off at rather low frequencies. That means that from a certain frequency upwards, the am-

plifying system would not transmit any other frequency. The use of a flywheel would not remedy that. As to what else was defective in the DeForest apparatus or reproduction it had some extraneous noises.

XQ. 90. Of course, it is true, isn't it, that in order to get good reproduction, or rather, in order to get a good musical or speech performance, there are a great many items in the recording and in the reproducing that are necessary to be done well and properly in order to get a good reproduction; isn't that true for a good performance?

A. Yes, sir.

XQ. 91. That is, your film may be badly made; your film may be badly developed; any number of things may go wrong in the apparatus, may it not? There are a great many things that have to be done right?

A. Yes.

The flywheel is not the cure for everything. That is, you may have a flywheel and still your performance may be very, very bad. And it might be true if your performance is bad without a flywheel, it may be bad because of defects that a flywheel would not cure at all.

In the Massolle, Vogt and Engl apparatus that I saw in Berlin, there was a photoelectric cell. I saw the part of the cell sticking out of the holder, and I took the cell for granted by the explanation that was given by the inventors. The cell was inside of a rotating cylinder. I think the dimensions of that hollow roller or cylinder were about a little bigger, I would say, than the standard sprocket wheel of the motion picture machines. That is, a little bigger diameter—bigger than the overall dimensions of the sprockets. And the cylinder that held the photoelectric cell was slightly larger than that. I would say 25 per cent. larger. That is a guess. The width of

the film that I saw being used there in Berlin, was not standard width, but wider. The sprocket perforations in the film were almost at the edge. It seemed to me that the sprocket—the distance between the sprocket holes was standard, and the film wider by an amount about twice the width of the sound record, I would say. And the sound record was outside of one line of sprockets. I think it was 42 millimeter film. I believe the standard is 36. In the Vogt apparatus I saw the flywheel. I could not say whether it was spring-driven or rigidly driven. I should say it was about five and a half inches in diameter. I do not know how much it weighed. I do not know what its moment of inertia was. As to whether I really know very much about that apparatus that I saw there. I was not only observing the performance because I was also observing the film at the point where the sound was transformed back into light and the amplifier beneath the projector, and so forth.

XQ. 116. And before you saw that apparatus late in 1921 or early in 1922, you had seen flywheels used on apparatus driving films?

A. Yes, but not in that position.

XQ. 117. You had seen them where: in the projectors?

A. Yes.

XQ. 118. And they were on constantly or continuously driven shafts, weren't they?

A. Yes.

XQ. 119. And the flywheel was there for what purpose?

A. To secure uniform running of the driving motor.

XQ. 120. Well, wait a moment. To secure uniform rate of rotation of the shaft on which the flywheel was fixed—that is true, isn't it?

A. That is the same thing.

MR. WARD: Your Honor, I object. I did not mind Mr. Neave going a little way, but now he is trying to use a witness here who has testified about particular demonstrations of DeForest and the inventors, he is trying to use him as a witness to prove the state of the prior art. We asked him nothing about that, nothing about the moving picture machines and their flywheels that he knew of prior to any particular time, and this thing is just going to drag out if Mr. Neave is going to delve into that, with this witness.

He has lots of witnesses here to prove the state of the prior art if he wishes to.

MR. NEAVE: The impression that this witness gave on his direct examination, or Mr. Ward in conjunction with him, was that it was a grand thing and a new and an unthought of thing, to use this flywheel in film apparatus, and I wish to remove that impression.

MR. WARD: He said the flywheel was used.

MR. NEAVE: He said it was better than the DeForest apparatus that did not have a flywheel.

THE COURT: You may proceed with the cross-examination.

THE COURT: And an exception for the plaintiffs.

XQ. 121. How long ago did you see that flywheel giving a constant rate of rotation of the shaft in moving picture projectors? I don't care exactly, but it was many years before 1921, wasn't it?

A. Yes, certainly.

In the apparatus that I saw in Berlin in the laboratory of Massolle, Vogt & Engl, for reproducing they used an incandescent lamp and for recording they used an electric glow tube, that is, a gas discharge

tube which was not shown in operation but was explained. These electrostatic loud speakers that I mentioned, they continued to use them. They used, as I recall it, three loud speakers mounted on the screen below the part where the picture was projected, and the diameter was about eight inches. The loud speaker consisted of two armatures, a fixed one and a movable one. The fixed armature was not solid, but was a sort of an eccentric rod structure, the purpose of which was explained by Vogt, and the movable armature was a very thin piece of mica which was silvered on one side to make it electrically conducting. The mica on the other side serving as the insulation between the very closely spaced two armatures of the condenser. It was just as electrostatic as a condenser, which is termed an electrostatic device. In other words, it has a super—it has a constant electric field and the alternating field is superposed on that field. I know what the Cathodophone is. It is not an electrostatic loud speaker. I have seen that working. That was shown at that same demonstration in the laboratory. It worked well, but I don't remember how sensitive it was. As to whether I doubt its sensitiveness, that depends with which you would compare it. Because it was used as a recording device.

An electric motor was driving that apparatus when I saw it in the laboratory. I could not say what the voltage was. The supply voltage varies a great deal in Berlin. The horsepower was probably a quarter. I don't remember that any beat note device was used to tell what the rate of rotation was. As to whether there was any special precaution taken to have the motor run at a given number of revolutions, it was explained to us that that was very important; but I don't think we were told how it was done. I don't think they drove it with an alternating current synchronous motor.

I could not say when sound pictures became successful and commercial in Germany, came into extensive use, because I left Germany in 1923.

I testified in the interference in this country, Tri-Ergon v. DeForest. Previous to doing that I had made some tests in this country about which I testified. I did not use the Tri-Ergon apparatus in my tests. In the tests I made I used only laboratory equipment. Not at all talking picture or ordinary motion picture apparatus. I did not use any Western Electric apparatus. I don't think I was present when Mr. Engl testified.

XQ. 149. You knew, didn't you, that he testified that the Western Electric amplifiers had been used in those tests?

A. I couldn't state anything about that.

I spoke of the DeForest work in Berlin. I don't know much about DeForest's work in this country, because I was at that time in Jersey City and DeForest and his Phonofilm Company in New York City; so I only saw demonstrations of his work. I think DeForest realized himself that he was having trouble with his amplifying system.

RE-DIRECT EXAMINATION.

By MR. WARD:

With regard to this demonstration that I have referred to where I saw the Tri-Ergon apparatus in the laboratory with the experts present, and as to whether I had any means of comparing the quality of the reproduced speech by the actual speech of any party during that demonstration, as I recollect it, Mr. Massolle gave us first in person a short exposition of their method, and afterwards we heard him talk in a talking film. I am not quite sure whether we heard him talk at a laboratory or at the Urania demonstration. He was present and talking in person in both

demonstrations. That is, I had an opportunity to observe the actual speaking of a party whose reproduced speech I also had the opportunity to observe through the projection.

The German post office controls the complete telegraph system in Germany. It comes under the German post office. So I was employed as an engineer in regard to amplifying work in the telephone and telegraph systems of the government. In that work I had to do with speech, mainly. My work gave me intimate knowledge in that line, of speech, transmission of speech and reproducing speech.

As to whether that was really directly in my line of work, it was during the last year I was with the post office. Therefore I was interested when I saw these demonstrations in the production of speech. Mr. Neave referred me to my knowledge of a flywheel on some motion-picture machine. In that motion-picture machine it was an intermittent movement, where the film was intermittently moved through the machine. As to his reference to a flywheel on some continuously rotating shaft, the fact was that it was an intermittent movement of the film through the machine at the translation point.

My work on behalf of the Tri-Ergon people in the DeForest interference related entirely to trying out some lamps that were supposed to be duplicates of Dr. DeForest's alleged early lamps and my construction of some apparatus for testing those lamps out. I had nothing to do whatsoever with attempting to carry out any work to demonstrate or illustrate the construction, arrangement or effect of any Tri-Ergon systems or apparatus. I am now employed by the Western Union Telegraph Company. My work is special development work in connection with vacuum devices. I have no interest whatsoever, financial or otherwise, in either of the plaintiffs here.

RE-CROSS-EXAMINATION.

By MR. NEAVE:

I haven't seen any motion-picture projector where the film—that is, the photograph, is reproduced by continuously moving film. I have read about the Mechau apparatus. But I have not seen them. I know by reading that in that apparatus the moving picture film moves continuously and not intermittently. I have not seen anything.

RXQ. 173. And you have seen that it is driven by shafts and rollers, there being a flywheel on the shaft?

MR. WARD: I object.

A. I doubt that I have seen that.

As to how large was the photo cell, and how much larger was the inside of the roller than is the diameter of the photo cell, in the apparatus I saw in the laboratory in Berlin, as I recall it, the photo cell fit pretty snug into the hollow cylinder. We have in this country a number of commercial photo cells which will fit into the standard sprocket wheel. I could name such cells by their commercial type. The one I saw in those laboratories in Berlin looked somewhat like the illustration you have shown me, but still there are some differences.

By MR. WARD:

I stated that that sprocket that I saw the PE-cell in that machine in Berlin was larger than the standard sprocket

## AFTERNOON SESSION.

JOSEF ENGL, called as a witness in behalf of the complainants, being first duly sworn, testified as follows:

DIRECT EXAMINATION,

By MR. WARD:

Q. 1. Dr. Engl, will you please state your name, age, residence and occupation.

A. My name is Josef Engl. Physicist. Thirty-nine years of age.

Q. 2. Have you any financial interest in the patent in suit or either of the plaintiffs in this case?

A. No, I have not.

Q. 3. Will you please state your qualifications as a physicist or scientist in the art of photographic sound on film sound pictures.

A. I began studying physics at the University of Munich, and spent about one year working in the laboratory of Professor Roentgen, the inventor of the X-rays. Then I went to the University of Berlin for some time. And finally to the University of Gottingen. In Gottingen I was two years assistant of Dr. Debye; and won a prize on a thesis. The title of this was "Physics of the Hydrogen Molecule." And I graduated at this university. That was 1916. Then I went back to Berlin and did some work at the firm of Siemens & Halske, work on X-ray tubes and X-ray—the methods of measuring X-rays and so on. After that I left the firm and joined with my two colleagues, Hans Vogt and Joseph Massolle, and we started in trying to develop a method of sound recording and reproducing for the purposes of the talking pictures.

Q. 7. Will you please state the character of that firm of Siemens & Halske; is it a large firm or a small firm?

A. Siemens & Halske is the largest electrical concern manufacturing all kinds of electric apparatus, devices, especially telephony, and amplifying tubes, measurement devices, and so on.

Q. 8. Do you lecture in any university in Berlin now, and on what subject?

A. Yes, since the year 1926 I am lecturing in the University of Berlin on the subject of physics.

Q. 9. When did you say that you and your colleagues, Vogt and Massolle, started work in developing the sound on film sound pictures?

A. It was early in the fall of 1918.

Q. 10. Before you go into that will you please state very briefly the experiences of Massolle and Vogt at the time that you started on this work?

A. My friend Massolle was, before we started this kind of work, an employee of the government. He designed and constructed radio receiving and transmitting stations during the war. He was a very well known electrical engineer, and he made quite a number of inventions on the subject of radio transmitting and receiving. My friend, Mr. Vogt, was a very well known engineer too. His name was especially known by his work on the so-called streamlined ground telephony—that is a sort of transmitting device where electric currents are sent through the ground and received on the different stations. He was an inventor of quite a number of devices for telephony, and a well-known expert in his art.

Q. 11. Doctor, will you please state at what stage you found the art of sound on film sound pictures at the time that you and your colleagues started in with your development work in the fall of 1918?

A. At this time the state of this art was about the following: it had been tried to couple synchronously gramophone discs with the known picture producing machine. But up to the time of 1918 no real

result had come out, no real result was found with this combination. About ten years before we started our experiments, a physicist by the name of Ruhmer had begun to photograph sound on film; but his experiments were just very crude beginning. He was able—I know of some publications of his—and he was able to just record speech so that you could understand that it was speech; and as a matter of fact, I found out some years later, I found some records of his and listened to them and they were really very crude, just the first experiments in this kind of work.

Q. 12. Were the results of his work of a character where you could recognize the voice of the person recorded, or anything of that sort?

A. Certainly not. You just could recognize that it was the voice of a person, but not at all the individual characteristic of his voice.

Q. 13. Now, will you please state, in a rather general way, to the Court how you and your colleagues started in on this work and give the highlights of what you did.

A. We began our work in the following way. We —our principal idea from the beginning was to use means for recording and reproducing which had no inertia; that is, which reacted instantaneously to any change, or rather, to changes of a periodicity which we have in the range of audibility, that is, from periods of about ten per second up to about fifteen thousand per second. So we decided almost from the beginning to use glow light discharge as a means of recording. We spent quite an amount of time in trying to develop a glow light discharge which gave enough light to produce sufficient density on the film. After we had succeeded in obtaining a glow light of this type we spent experimental work on photoelectric cells, checking up the properties of those—of the so-called photoelectric cell. When we were finished with this work we in-

vestigated the difficulties which we found in recording and reproducing; that is, we experimented with records made with our glow light discharge light source, and looked how the reproduction was, whether the reproduction was a true copy of what originally had been spoken into the microphone.

Q. 14. Now, with respect to the recording light to record the sound, why did you, after your experimentations and determinations, determine to use the glow light?

A. We had to have a source of light which responded without any inertia to all of the frequencies involved in this problem. The frequency range I mentioned just a few minutes before.

Q. 15. That is, the glow light had to respond instantaneously without lag or persistence to the variations in the circuit to which the light was connected?

A. Yes. And I might add at this moment that this light source had to have another property too. There must be a strict proportionality between the light intensity emitted from the light source and the modulations superimposed to the light source.

Q. 16. And in the course of that work on the glow light, you also determined that the glow light should be constantly energized and then the varying currents from the microphone superimposed on that potential?

A. Yes.

Q. 17. You filed patent applications on that idea?

A. We did.

Q. 18. You have referred to your use of the photoelectric cell, I believe, for the reproduction?

A. Exactly.

Q. 19. Will you please state whether the photoelectric cell per se as an article was known in the literature at the time that you started your work?

A. Yes. The photoelectric cell by itself was known in the literature. Quite a number of experiments had

been made by different physicists with this photoelectric cell. It had been known since I think the year 1894. In this year the physicists Elster and Geitel first constructed a photoelectric cell which had about the same properties as we used it later on.

Q. 20. Can you state to what extent the photoelectric cell was at the time you started in, known as an actual article in use, in practical use? That is, was it an article that you could go out and buy, or to what extent had it been known as an article?

A. No, it was not an article at all that you could buy in the market. As a matter of fact, the cells we needed for our purposes we had to manufacture ourselves. We had the glass vessels made and distilled the alkali metal in these cells and pumped them ourselves and tested them ourselves.

Q. 21. Now, will you please state to the Court the requirements for a light-sensitive element or device which would be useful for sound reproduction in accordance with your system.

A. A light-sensitive device which would be useful for sound reproduction has to have three distinct features. First it should have no perceptible inertia,—that is, there should be a lack of any time lag in the cell and a lack of persistence in the cell. To illuminate the cell, the photoelectric current created in the cell should have instantaneously a value corresponding to the illumination of the cell, and if I shut off the illumination, the photoelectric current must disappear instantaneously as well.

The second feature is that a cell useful for sound reproduction should not show any fatigue. That is, the sensitivity of such a cell should be constant all the time over. The sensitivity means the reaction of the cell to the illumination. In other words, if I illuminate the cell at different times with the same amount of light

energy, the photoelectric current created should be exactly the same.

And the third property of the cell is that there should exist a strictly linear relationship between the illumination and current flowing through the cell. And that, for all of the frequencies involved, frequencies from the beginning of the audibility range, say 16 per second, up to the end of the audibility range, say 15,000 per second.

Q. 22. By that you mean that the characteristic curve of the cell between the illumination, the varying illumination to which the cell is subjected, and the current output from the cell, all through the acoustic ranges, should be in exact proportionality so that your line should be a straight line?

A. Yes, that is what I mean.

Q. 23. Now, Doctor, will you please state, at the time that you started in which, if any and, if any, to what extent, were these properties of the photoelectric cell recognized by scientists?

A. The properties of a photoelectric cell were disputed quite heavily in the literature, in the physical literature. Experiments had been made on fatigue. Some physicists found that there was fatigue. Others found that there was none. Experiments had been made by Elster and Geitel themselves on the linear relationship between the illumination and currents. They found that they existed to a certain extent, the linear relationship. Other physicists found again that the relationship did not exist. About the freeness of the inertia, there had been made no experimental investigations at that time. There had not been made any experimental investigations at that time. So we had to check it up, to check up all of those properties of the cell ourselves again to be sure that a photoelectric cell would be a desirable thing for sound reproduction.

Q. 24. I think you failed to state, Doctor, whether there had been any agreement among the scientists on the point of the straight line characteristics or proportionality of the cell.

A. I am sorry. I thought I told that. That Elster and Geitel made investigations and found a proportionality, and others repeated that and found not.

Q. 25. Was that with respect to fatigue and the porportionality?

A. I spoke of the fatigue before that.

Q. 26. You say that some of the scientists found that some of these characteristics existed and some found that they did not. I suppose what you meant to say was that some of them thought that the characteristics existed as a result of their experiments with the cell?

A. Yes.

Q. 27. Will you state what actual uses, if any, the photoelectric cell had been put to at the time you started your work?

A. At that time I knew only of two uses of the cell. It was in the use of the photometric purposes in this kind of experiment, of course, only where constant illuminations were used, so that that would not say anything about rapidly changing illuminations. And another very scientific use of the cell was for the photometry of stars, the light intensity of the stars was measured by the photoelectric cell.

Q. 28. That is to say, as I understand your testimony, the only use you knew of at that time that the cell had been put to, was to measure the candlepower or extent of illumination of a lamp or stars?

A. Yes.

Q. 29. And the light coming from either of those sources on to the photoelectric cell would be a fairly constant light?

A. Yes.

Q. 31. What have you to say as to what such uses as this would determine with respect to the photoelectric cells having inertia with varying illumination, such as has to be used for sound reproduction?

A. You could draw no conclusions, using the experiments made with the photoelectric cells for photometry. You could draw no conclusions relating to the use of the cell for sound reproduction, because in sound reproduction you have a changing illumination.

Q. 32. That is, you have a rapidly varying current or illumination responsive to the sound record, which you do not have in measuring the candlepower of the lamp or star?

A. That is so.

Q. 33. In addition to this, what have you to say as to the existence of instruments which could have measured the characteristics of the photoelectric cell over the acoustic range at the time you started in, as to its response, straight line characteristic throughout the acoustic range? Were there instruments available that you could determine that on, or did you have to construct some means yourself of doing that?

A. We had to construct our arrangements for checking up this relationship ourselves. We had to see that the illuminated photoelectric cell produced a certain frequency with a certain intensity of illumination, and to see what shape and amplitudes the current created in the photoelectric cell had.

Q. 34. Then the fact is that when you started in with this work, as far as your knowledge went, it was not known and you did not know that the photoelectric cell had these characteristics which were necessary for proper sound reproduction?

A. No, we did not. We had to investigate.

Q. 35. Up to the time of the commencement of your work, what was the classical device used in pro-

posed efforts in patents and literature and by those that had tried some work, as far as they went in sound reproduction?

A. A device used quite often and proposed to be used quite often was the so-called selenium cell. As a matter of fact, the physicist I mentioned a few minutes ago, Ruhmer, used in his experiments a selenium cell.

Q. 36. And has the selenium cell got any or all of the characteristics that you found that the photoelectric cell had?

A. No, it has not. It has fatigue. There is no equal response of the cell to all frequencies necessary in this kind of experiment, and there is not even a linear relationship between illumination and current going through the selenium cell.

Q. 37. Now, Doctor, you have traced your work in regard to the recording light and its circuits, and the photoelectric cell. Will you please take up your work from there on in regard to the control, positioning and movement of the film through your machine, and explain that to the Court.

A. After we had completed our work with a glow light and with a photoelectric cell, we actually began to record and reproduce films. And we constructed in the course of the time different frameworks which allowed us to try different arrangements for moving film through the machines.

Q. 38. Will you please continue and describe to the Court how the first machine that you started with was constructed?

A. The first machine we constructed had a wooden framework which allowed us to record on film. The film was run in a light tight box and brought into motion by an electric motor with a driving arrangement. The film was moved beyond a very narrow slit, the slit was illuminated by the light source, that is, the glow

light discharge. The same framework we used for reproduction purposes. The film was inserted again and run through the machine by means of a driving electric motor. At the place where the glow light discharge for reproduction was, a constant strong light source was put and behind the slit we arranged the photoelectric cell. The film ran between the slit and the photoelectric cell. I would rather like, if I am allowed, to demonstrate the details by using a photograph of this framework.

Q. 39. Will you please refer to this photograph?

A. These are two photographic views of the first wooden framework we used. Here your Honor sees the wooden box and a driving mechanism. There is a motor here and different pulleys. All the shafts are going through the wooden box, and on this shaft here you can see a flywheel. The film ran about this way. You can see by looking at the interior of the box. Here is a magazine and here is another magazine. And the film ran from this magazine over this cylindrical shaped member, and over a sprocket wheel which drove the film into the upper magazine. On this sprocket wheel which drove the film the flywheel was in some of our experiments fastened. Just in front of this cylindrical member, this narrow slit was attached. At this point we applied the glow light discharge for recording purposes or a strong source of light for reproducing purposes. We used the same structure for both purposes.

Q. 40. Now, Doctor, you have described that machine to the Court, and I will ask to have these prints of the machine that you have used marked for identification as Plaintiffs' Exhibits 18 and 19.

(Received in evidence and marked Plaintiffs' Exhibits 18 and 19.)

Q. 41. Now, was that framework, shown in that machine, was that used only with the particular ar-

rangement of gears and so forth shown in that photograph, or, was that used for other experimental work?

A. With this framework we made investigations about a series of different driving arrangements. I remember distinctly that with our first experiments we relied only upon the constancy of speed of the driving electro-motor. We had a special type of electro-motor which gave constant revolutions per minute. We very soon found out that the constancy of the speed was not sufficient enough. Then we tried a number of experiments, as follows: For instance, we gave the motor—the armature of the motor rather, an additional load. We put in the armature short circuited copper bars, so that eddy currents were created in this armature in order to have an additional load on the motor. Constancy increased, but was not sufficient for the purposes. Then we put a flywheel on the motor.

Q. 42. Now, one minute, Doctor, before you get to the flywheel. As I understand your testimony, the first thing you did after you found that there were irregularities in your recording and reproducing—after you had the glow light and the PE cell and found out that there were these irregularities, the first thing you did was to try and render the speed of the driving motor itself more constant?

A. Right, sir.

Q. 43. That was the first line of work?

A. It was.

Q. 44. Did you feel that the trouble was at the speed of the motor itself, or what caused you to first tackle the speed of the motor?

A. We did not feel anything definite about the source of the trouble. We just tried to check up all the parts of the arrangement, one after the other one, until at last we must have found the source of the trouble.

Q. 45. And your first thought was that it lay at the speed of the motor?

A. Yes, that is right.

Q. 46. Now then, after you had done your best, as I understand it, to steady up the speed of the motor by reconstruction of the motor itself and the use of the copper eddy current discs, what next did you do?

A. I think I told that the next step we took was putting a flywheel on the motor shaft.

Q. 47. And that one of the constructions with the use of the flywheel—did you say on the motor shaft? I beg your pardon?

A. I spoke now about putting a flywheel on the motor shaft.

Q. 48. Then the next thing you did after rearranging the motor armature and putting on this copper eddy current disc, was to try a flywheel on the motor shaft?

A. Exactly.

Q. 49. And then what did you do, if anything, after that?

A. With the last arrangement we had not yet solved the irregularities of speed, we then put the flywheel nearer the point which we considered the danger point of the whole arrangement, and the pictures I just showed——

(Photograph was marked Plaintiffs' Exhibit 18 for identification.)

—gives an arrangement where we put the flywheel on the shaft of the driving sprocket wheel.

Q. 51. That is, by driving sprocket wheel you mean the sprocket that fed the film past the translation point?

A. Exactly, yes. I might point out here that when at this state of our experiments, we ran the

film around a curved surface. You see that the film is moved around this curved surface. The film is moving from this magazine around this curved surface.

Q. 53. Will you please mark that curved surface with a letter or numeral so that we can get it?

A. Which letter do you want?

Q. 54. "1" will do.

A. The film is tightened by the sprocket wheel running it over this curved surface here. This curved surface just consisted of the outer surface of the cylinder in which the photoelectric cell was placed in the case of reproducing, and which was not used at all in the case of recording.

Q. 55. Now will you kindly give the numeral 2 applied to the sprocket which fed the film past that curved surface?

A. I did.

Q. 56. Now, in recording the cylinder was used, but the cell was not inside of it?

A. No, that is right.

Q. 57. Now Doctor, will you kindly state some of the other constructions, if there were any—other arrangements used in the course of your work in applying the flywheel to the film?

A. In the further course of our work we constructed a second framework, which was intended for recording pictures on film synchronously with sound. Framework 1 only allowed the recording and reproducing of sounds. Framework 2 allowed the recording and reproducing of pictures and sounds.

Q. 58. Is that it?

A. That is it. That was a wooden, a big wooden structure, again, containing in the base the amplifying arrangement, and containing in the top part of it the driving mechanism and the optical arrangement.

(Print was marked Plaintiffs' Exhibit 19 for identification, later 19-A in evidence.)

In this case we have again the optical arrangement, at the vertical axis, the light source being in this container at the top of the whole structure. This barrel contains lenses. Here we have the slit, and here we have the point where the film was exposed to the light. You see, from this picture at that time we had no more any physical slit in the vicinity of the film, but the optical image of a slit reduced in size by an optical system on the film. The film was driven by mechanism which is not shown here because it is on the other side of the structure. Here are two magazines, film run over a sprocket wheel again——

Q. 61. Please mark that with a numeral.

A. Which number?

Q. 62. "1."

A. —run then past the translating point here, just below the optical axis of this. Then over a second sprocket wheel, then back over the first sprocket wheel into the magazine. The second sprocket wheel is here. I want to point out that we used different arrangements again with this structure. Sometimes we used only one sprocket wheel, the film running around this sprocket wheel over a curved surface here, containing, for purposes of reproduction, the photoelectric cell, and back into the magazine again. At other times we used the running of the film over both sprocket wheels. Both sprocket wheel shafts had flywheels. We used flywheels once at one shaft only; and, at some of our experiments, on both shafts.

Q. 63. At this point, Doctor, I show you a large picture of Figure 1 of the drawing of the patent in suit. Does that last photograph which you have explained indicate the arrangement in Figure 1, or are they different?

A. If you turn it at right angles, it is about the same arrangement as we used in a series of our experiments with structure 2.

Q. 64. Now as I understand it, however, in connection with that structure shown in the Exhibit 19 for identification, there was a curved surface over which the film passed——

A. Exactly.

Q. 65. Instead of having the film just pass right by an edge as is shown in the drawing in the patent, Figure 1?

A. That is right. There is a difference in so far as in this patent drawing Figure 1 the running of the film over the curved surface is not shown clearly enough as it actually was.

Q. 66. That is, you are referring to the structure in the patent supporting the PE cell?

A. Exactly.

Q. 67. Where it is not shown supporting the curved surface?

A. Yes.

Q. 68. Now, as I understand you, in some of your experiments some of the machines built on that frame of photograph Exhibit 19 for identification, later in evidence as Exhibit 19-A, in some cases you had the two flywheels on the two rollers as shown in Figure 1, and in others you omitted one of the flywheels?

A. Exactly. Yes.

Q. 69. And you ran the film over a roller which would take the place where this PE cell is shown here in the Figure 1?

A. Yes. As a matter of fact, I found, looking in old notes of the laboratory, I found a number of sketches and data on our experiments which show that we used those arrangements at a certain time.

Q. 70. You referred to one of your laboratory books showing some sketches. I will ask you what this book is that I hand you?

A. This book is one of the files we used at the time of our experiments. I would like to point out

that quite an amount of those notes has been lost, and it is just a matter of luck that I was able to find these few experimental data again. We have quite a series of experiments at that time. Here, on those two pages of these laboratory notes, I find strips of film made——

These notes are dated February 8th, '21, for instance. The records have been made in order to check up the constancy of the film, running film. Here, we just made very scarce notes, as your Honor will see. Here you see the arrangement, for instance, of a sprocket wheel having on the shaft a flywheel—as I told a few minutes ago—film running this way over a second flywheel without any sprockets in this case here; the shaft running—idling in the bearings; and back again over the first sprocket wheel into the magazines.

Q. 71. You said that the second element over which the film runs was a flywheel. Do you mean a flywheel or roller, or sprocket?

A. Roller and—no; I mean the film running over here, over a roller without any sprockets, but having a flywheel on. Here the photoelectric cell was placed, Z means photoelectric cell, that is the end, front end of the microscopic lens shooting the light down in a vertical direction. This was another arrangement, for instance, where we didn't use this second flywheel; only the first one on the sprocket wheel shaft. It showed here just to——

Q. 72. One minute. For the record, may I clear up a little bit for the court—the Court of Appeals, probably. The first sketch that you referred to in your notebook seems to have the—shows the film coming under a guide roller, and over a portion of a sprocket to which you say a flywheel is connected, and then past the PE cell at the translation point, and over what you say is another roller, which sometimes had a flywheel and sometimes not?

A. Exactly.

Q. 73. And then back——

A. Again.

Q. 74. To the other side of the first sprocket where it is guided off the sprocket by a roller. Is that substantially the idea shown in Figure 1 of the patent in suit?

A. Yes, perhaps only with the same difference that I like to emphasize, the fact that the film was pressed against this cylindrical surface here, so that it run around it on a certain part of the periphery.

Q. 75. That is, as I understand it, at the translation point your film was supported on a curved surface as it went by——

A. Yes. Exactly.

Q. 76. Against which it was pressed. Now, then, you referred to a second figure shown on the same page, and pointed out that there was a sprocket corresponding to the sprocket of the first sketch, and then there was the photoelectric cell, and also a third roller, but that the film did not go over the third roller of the three elements.

A. Exactly.

Q. 77. But after it left the first sprocket, the driving sprocket, it went around the central cylindrical member or roller back to the first sprocket?

A. Yes.

Q. 78. Now, will you state to the Court just what that central member Z was besides having the PE cell in the center of it?

A. It consisted of a metallic cylinder against the periphery of which the film was pressed by putting tension on the film with these pressure rollers here. Just——

Q. 79. Was it a stationary or a rotating member?

A. It was a stationary member.

Q. 80. That is, the sprocket fed the film around a stationary cylinder, around which the film went back to the other side of the feeding sprocket and the translation point was at that stationary cylindrical member?

A. Yes.

Q. 81. And in this case the flywheel is attached to what?

A. In this case the flywheel was attached to the shaft of the sprocket wheel.

The film record here was made with a frequency, as I take it from the notes, of 4500. It is possible to detect here on the points indicated with ink, small—weak, rather, variations in density. Of course, these variations in density are not the variations corresponding to 4500, but, corresponding to some trouble occurring in the whole arrangement. And as we found out the teeth of the sprocket wheel created these small changes in density, which mean not constant speed of the running film, with another arrangement we were able to get rid of those changes. We got rid of the trouble, apparently, in this second record, which does not show those changes in density.

On another page of these notes, I have here records which show the way we checked up the speed of the film over a longer period of time. There is a very weak record on that, taken from the beginning of a long strip of film, and this part is taken from the end of a long strip of film. Comparison of both records showed us that there was no detectable variation in speed over this longer period of time. I would like to add at the moment, that we took quite an amount of experimental work and time to find out the troubles about the inconstancy of the film speed and to adjust our arrangements in such a way that we had actually constant speed.

Q. 84. Now, you have referred to first trying to obtain the constancy of speed or the lack of irregulari-

ties in the speed of the film passing through the machine, by working on the constancy of speed of the drive shaft and the driving motor, and that later on, after that did not give you the results you were after, you decided upon applying the flywheel to the roller or sprocket over which the film passed adjacent the translation point. What made you decide, if you know, to put the flywheel at this point rather than at the point of the motor where you first tried it? Did you decide that there were any difficulties that would be overcome by placing it there that would not be overcome by placing it elsewhere?

A. We thought that part of the film being mostly in danger which was nearest to the translating point, that was the reason why we put the flywheel in that position.

Q. 85. Would the flywheel being put in that position filter out any difficulties that it would not filter out or take care of if put elsewhere?

A. Yes, it would filter out the disturbances—the irregularities in the motion of the film.

Q. 86. What, if anything, would it do with respect to any irregularities in the gearing between the drive motor and that point?

A. The flywheel being applied to a part of the film beyond the points where the film was in contact with any other parts of the driving arrangement, would insure that the speed of the film is constant although the other driving parts of the machine might not run constantly.

Q. 87. What is a flywheel placed in such a location and so acting, generally known as? What kind of a flywheel?

A. We called it at that time on account of the action of the flywheel, cutting out all of the irregularities of the driving mechanism, a filter flywheel, a flywheel which filters out all of the undesirable irregularities.

Q. 87a. Is it still known as such, as far as you know?

A. As far as I know, it is still known as that.

Q. 88. Now, I show you another photograph, which has been marked for identification as Plaintiffs' Exhibit 17, and ask you if you can tell us what that is.

A. This photograph shows a third improved arrangement for reproduction of sound picture films. At that time we had in the construction a flywheel which was coupled resiliently to the driving mechanism. That means the following: the flywheel shaft on which the sprocket wheel feeding the film passes the translating point, was not fastened or coupled directly to the driving mechanism but brought into motion by an arrangement of stops. Between the stops and the flywheel we attached springs. When the whole thing was running the stops did not touch the flywheel arrangement at all, but the energy necessary to overcome the frictional losses in the bearings of the flywheel shaft was contributed to the flywheel by these little springs.

Q. 89. You mean transmitted?

A. Transmitted to the flywheel by these little springs.

Q. 90. Now, will you please take that picture up to the Court and explain briefly to him the construction of that machine?

A. This is the picture head of the machine, an ordinary picture head which we bought on the market at that time, with an arc light housing here. The pictures being thrown in this direction on the screen. After the film had passed the picture head, it went down here to this part of the arrangement, which was the sound arrangement. It ran down a chute-like arrangement over a sprocket wheel.

Q. 91. Will you mark that sprocket there with the numeral 1.

A. I have. Over the sprocket wheel, pressed on to this sprocket wheel, by pressure rollers. Back over this chute arrangement again, over this sprocket wheel down to the magazine. On the shaft of this sprocket wheel 1 a flywheel was attached in the way I have just explained, that is, driven by means of springs.

Q. 92. Was a photoelectric cell used in that machine for reproducing?

A. Yes, this sprocket wheel was a hollow structure.

Q. 93. The sprocket wheel 1?

A. The sprocket wheel 1 containing in the interior the photoelectric cell. The film was not of the standard width of 35 millimeters but was wider than that, 42 millimeters at that time, and overhung the sprocket wheel with a part of its width so that the light could go through freely. The light was shot here from a source of light which cannot be seen because it is behind the amplifying tubes, through a microscope, the front lens being here, through the overhanging part of the film, and into the photoelectric cell.

Q. 94. I hand you a strip of film, Doctor, apparently having a sound record and picture record on it, and ask you if that refreshes your memory as to anything.

A. Yes. This strip of film is a piece of a film made at that time in our laboratory. Your Honor will see the two series of perforation holes——

Q. 95. At what time was that film made in the laboratory?

A. This film has been made—let me think——

Q. 96. Just give the year. That will be close enough.

A. Just one moment. 1923.

The distance between the perforation holes is the standard distance, but there is a part of the film which is wider and a part is on the outside of one series of

the perforation holes. This part carries the sound record consisting of lines of varying intensity.

Q. 97. That is, that is the part, that part which carries the sound record is the part which you say projected over the edge of that sprocket in the picture Exhibit 17 which you have before you?

A. Exactly.

Q. 98. And the light was shot through that overhanging part of the film on to your photoelectric cell?

A. Yes.

Q. 99. While you happened to have that piece of film, Doctor, that you have just looked at, will you state whether these perforations are the same in outline as the perforations in the present day standard film?

A. There is a difference in the form of the perforation holes we used at that time to perforate the film we needed ourselves, with a perforation machine which we constructed in our laboratory. The results we got from film bought in the market did not seem at that time of sufficient uniformity to insure us of the film being of a quality which gave constancy.

Mr. Ward: I offer in evidence the piece of film referred to by the witness and ask that it be marked Plaintiffs' Exhibit 20.

(Received in evidence and marked Plaintiffs' Exhibit 20.)

Q. 100. I hand you this piece of film, Plaintiffs' Exhibit 20, together with another short piece of film, which I will state is a piece of standard film, and ask you to point out to the Court the difference in outline of the sprocket holes in those two pieces of film.

A. The sprocket holes in our film has a form of a quadrangle with almost equal sides. The side of the quadrangle in the direction of the motion of the film

is a little bigger than the sides parallel, the sides which are in the parallel position with the direction of the motion. The film you gave me for comparison shows perforation holes where the sides of the quadrangle at right angle with the direction of motion are longer than the other sides. Furthermore, the corners of the quadrangles are rounded off a little more in the piece of film you gave me for comparison, compared with our own film.

Q. 101. Then if I may sum up the differences—in your film the holes or the sprocket holes in the film are squarer than the standard film and have not the corners smoothed or curved out, the corners of the holes smoothed out as in the standard film?

A. Yes.

MR. WARD: I now offer in evidence the short strip of film called standard film and ask that it be marked as Plaintiffs' Exhibit 21.

(Received in evidence and marked Plaintiffs' Exhibit 21.)

Q. 102. Now, Doctor, will you state the year in which you first demonstrated any of these machines of yours, using a flywheel on the shaft of the roller or sprocket where the film passed over it in the sound head. Will you state when you first demonstrated that machine to others than you and your colleagues in your laboratory?

A. We made our first demonstration of synchronous picture and sound with the framework called No. 2, this wooden structure, in the spring of 1921.

Q. 103. When you say No. 2, which of these is it?

A. This one. The framework shown in Exhibit 19-A.

We showed at that time to a committee of people who assisted us with money, a series of records con-

taining speech, different speeches of different people, then a song, and a recital by a lady singer, and some music.

Q. 105. What was the quality of the sound reproduction in this demonstration?

A. As far as I am able to judge, as one of the inventors, we considered it fairly good.

Q. 106. After that first demonstration did you give any other demonstrations prior to the time that you gave any demonstration in the theatre?

A. Yes, we gave demonstrations to people connected with our capitalists.

Q. 107. You heard Dr. Holborn's testimony here this morning. Do you recall the demonstration that he referred to as witnessing?

A. Yes, I recall Dr. Holborn being present at one of those demonstrations. These demonstrations I would like to point out that, as far as I remember, these demonstrations were made with a machine I described as the third construction.

Q. 108. That would be the one shown in Exhibit 17?

A. Yes.

Q. 109. Then when did you give your first theatre demonstration?

A. During the course of the year 1922, especially as I remember during the summer time we were able to record quite a number of subjects in a studio we adapted for our purposes, and as a result of this work done in the studio we were able to show, September, 1922, in a public theatre, a program of sound picture films to invited people.

Q. 110. What theatre was that?

A. That was a theatre called the Alhambra Theatre in the City of Berlin.

Q. 111. I show you a card and ask you if you know what that is?

A. Yes, that is a card of the invitation. That is a copy of the invitation cards inviting the party who received the card for the first demonstration of acoustic films on Sunday, the 17th of September, 1922.

Q. 112. That is one of the original cards?

A. Yes.

Mr. Ward: I offer that in evidence as Plaintiffs' Exhibit 22.

(Invitation card for demonstration, September 27, 1922, received in evidence and marked Plaintiffs' Exhibit 22.)

Q. 113. Just state briefly what machine was used at that demonstration.

A. At that demonstration the machine was used, the picture of which you happen to have in your hands.

Q. 114. That is Exhibit 17?

A. Yes.

Q. 115. Was anything more done in regard to further demonstrations after the Alhambra Theatre demonstration?

A. Yes; I remember that we made a second or third private demonstration in the Urania Theatre in Berlin, and then showed the program against entrance fees in the same theatre.

Q. 116. That was in 1922?

A. 1922.

Q. 117. Did you build any additional machines after this and, if so, what did you do with them?

A. About the same time we built three or four machines of the same type just mentioned, and showed the program we had in different cities in Germany and Switzerland.

Q. 118. Did you ever give an order for any substantial number of machines, of these machines, which were built later on?

A. In the spring of 1924 we just finished a new construction, which was more adapted for easily moving around. I might say that this machine shown in this exhibit was a very heavy iron structure.

Q. 119. You are referring to Exhibit 17?

A. Yes. I just stated that we finished in constructing a new machine on the same principles. The blueprints for the workshop were, as I remember, finished in the spring of 1924. It took us until about in the middle of the year of 1925 to build a lot of 25 machines.

Q. 120. That is, you gave the order for these in 1924 and the last one was completed some time in 1925?

A. Exactly.

Q. 121. What was done with this lot of 25 machines?

A. They were used in showing programs in the country for some time. The showing of these programs ended when we had no more new films to show, and as far as I know several of them were sold to people interested in the new inventions.

Q. 122. Before I get to the reason why they were not continued: with regard to this lot of 25, how were they handled? Were they installed in theatres and, if so, where?

A. They were installed in theatres in different cities of Germany and Switzerland, but not sold to the theatres. We rather rented them either against a royalty per day, or a certain participation in the cash returns of the theatre owner.

Q. 123. I have a sheet of paper in my hand here, Will you tell me what that is, if you know?

A. That is a series of picture houses apparently in different cities of Germany, giving the time of the shows and the sums either of guaranteed royalty by the party or the percentage of the money that we ought to receive.

Q. 124. This list has some 29 items on it. Will you look at that and state whether that means that there were 29 theatres in which the machines were exhibited and, if not, just what does it mean?

A. Yes. Each one of these 29 items means a different theatre. I doubt whether this list is complete. As far as I remember, in more than 29 theatres our films were shown.

Q. 125. Will you just read off one of the earliest and one of the later dates?

A. The first is the Marmorhouse in Berlin. It states that films were shown beginning the 17th of January up to the 6th of February. That is 21 days. And apparently we got 15 per cent. of the gross return of this theatre owner. The second one says in Rolandshof in the City of Muenster. The third one, giving details of the City of Elberfeld at the Scala. Apparently there were two shows in that theatre, because there are figures for 17 days and 7 days. For Stettin, at the Urania——

Q. 126. You don't have to read them all.

Mr. Neave: What is that there?

The Witness: The sum we got from the theatre; the amount in marks.

Q. 127. Was that in gold marks?

A. Gold marks.

Q. 128. This was in 1924—or what year?

A. It starts January, 1924, and this list goes up to the end of June, 1924.

Q. 129. Can you state where this list came from?

A. I guess it is an extract of some accountant's books.

Q. 130. Do you know anything about this list? Do you know anything about those installations at all?

A. I doubt whether I know very much because I see that at the time of the end of this list I was not in Germany. I was in the United States.

Q. 131. Do you know whether any of your machines were installed in any of those theatres on that list?

A. I am sure about the first one, for instance; and I know about the fourth in Stettin, and I know about the eighth in Hanover. I know about the sixteenth, Bremen. The 21 again, Halle. I think that is about all.

MR. WARD: Your Honor, I cannot offer that in evidence, because I have nobody here to prove the definite complete list. Dr. Engl was not in the commercial end of it and I can only have him testify as to what he knows about it.

Q. 132. I understood you to say that you did of your own knowledge know that these machines were leased, and they were either leased on one of the two bases, either for a percentage of the gross that was paid in, or else for a definite price?

A. Yes.

Q. 133. Now, Dr. Engl, have you any photographs here of the type of machine that that lot of 25 consisted of?

A. I think one of these machines has been brought over by myself to your country.

Q. 134. I hand you a photograph and ask you if you know what that shows?

A. This shows a photograph of the sound picture head of one of the machines of the lot of 25 mentioned just before.

Q. 135. Does this second photograph bear any connection to it?

A. Yes. The second photograph is another view showing the driving motor and the flywheel.

Q. 136. You say that this represents the sound head of such a machine. This photograph does not show the picture of the motion picture part?

A. I said the sound picture head.

Q. 137. The motor connection of that machine. Is that the same as it was or has that been changed?

A. No, that is not the original connection. The original connection was a straight connection between the motor shaft and driving shaft gear. That seems to be new.

MR. WARD: I would like to offer the two photographs referred to by the witness in evidence as Plaintiffs' Exhibits 23 and 24 respectively.

(Photograph of type of the lot of twenty-five machines is received in evidence and marked Plaintiffs' Exhibit 23.)

(Another view of the same machine is received in evidence and marked Plaintiffs' Exhibit 24.)

Q. 138. Will you please take these photographs, Plaintiffs' Exhibits 23 and 24 respectively, and point out to the Court the arrangement of the film feed and its support and speed control through that machine?

A. The film is passed from this magazine through the opening here, over this sprocket wheel, through the picture showing mechanism. Here through this big opening here, the arc light housing is fitted for picture reproduction. The film is exposed to the light of the arc in this head and the picture of the frame is thrown by means of this lens, on the screen. The film is then fed farther on over this intermittent sprocket wheel, which runs it by jerks.

Q. 139. That being the intermittent sprocket driving the motion pictures intermittently through the motion picture sound head?

A. Yes. Then a loop is made so that the intermittent motion of the film in the picture head is not influencing the steady motion of the film in the sound part of it. After this loop, the film runs over this sprocket wheel, the sprocket of which you see here.

On the periphery of this sprocket wheel the film is exposed to the light, the sound light. The sound light is in this housing here, and a slit about in this position, the slit is illuminated by the bulb in here, and by means of that microscope lens, a narrow line of light is thrown on to the film. In this cylindrical body a photoelectric cell is mounted, that is, in the interior of the sprocket wheel. The sprocket wheel is hollow and the cylindrical body here inserted into the sprocket wheel. After the film having passed the sprocket wheel, it is fed over this sprocket wheel here, and then down to the picking-up mechanism.

Q. 141. Will you kindly point out by reference numerals where your light source is?

A. The light source for the sound?

Q. 142. Yes.

A. That is No. 1.

Q. 143. And where your translation point is where the fine point of light is projected on to the film?

A. I will give No. 2 to this point, the translation point.

Q. 144. And will you give a numeral to the sprocket over which the film moves and which contains the photoelectric cell?

A. I will give that the No. 3. The photoelectric cell arrangement I will give the No. 4.

Q. 145. And you stated that after the film passed over the sprocket 3, it went to where?

A. Then it goes over this sprocket wheel.

Q. 146. Will you number that one?

A. I will number that 5. Down into the taking-up magazine.

Q. 147. That is on photograph Exhibit No. 24. Now, will you explain to the Court the other view and, in doing so, use numerals on the more important points so that the record will show clearly?

A. Here again we have the sound light which I will give the No. 1 to. The microscopic lens and the sprocket wheel, to which I gave the No. 3 in the other picture, and the photoelectric cell which I gave the No. 4. The film runs over that here. This is the translating point. This sprocket wheel 3 is on a common shaft with the flywheel No. 6. The flywheel is spring driven. The springs cannot be seen because they are in the inside, but if I go back to the first picture here your Honor can see the spring. This is the spring and this is the driving stop. This is on one and the same shaft as the flywheel, but independently of the flywheel so I can move this flywheel together with the sprocket at least partially independently from this driving mechanism. The driving mechanism is coupled rigidly to the gears and then to the electric motor. This is a resilient coupling of the driving shaft with a flywheel.

Q. 148. I hand you another photograph and ask you to compare it with photograph No. 23, which you said was another view of the machine shown in photograph 24, and ask you if you observe any differences in those two photographs?

A. Yes. Here in the picture I have given numbers to, the shaft carrying the flywheel has a roller apparently without sprockets. The sprockets are no more there. They are apparently cut off from the sprocket wheel, whereas in the picture you have given me just now there is a sprocket wheel here easily showing the sprockets on it.

Q. 149. In other words, the picture Exhibit 23 has the smooth roller on a shaft instead of the sprocket wheel there?

A. Yes.

MR. WARD: I ask that the last photograph handed to the witness be substituted as Plaintiffs' Exhibit 23 and I withdraw the old No. 23.

Q. 150. Will you take the new Exhibit 23 and briefly state and point out the parts in that and give them the same numerals which you gave them in old Exhibit 23.

A. In this picture I see again the sound light which I give No. 1, and the sprocket wheel which I give the No. 3. The sprocket wheel containing the photoelectric cell 4.

Q. 151. You referred to the fact that this illustrated the type of twenty-five machines that you had built. I show you a copy of a letter and ask you if you know what that is?

A. This is a copy of a letter from Zurich, from the managing director of the Tri-Ergon A. G. of Zurich to the laboratory in Berlin, dated May 2d, 1925.

Q. 152. State briefly what it states.

A. It refers to the construction of fifteen reproducing machines and five recording machines. It mentions that blueprints of this reproducing machine were completely designed and worked through the end of June, 1924.

Q. 153. Will you state whether the machines referred to in this letter were a part of the order of twenty-five or some different machines?

A. They were a part of the order of twenty-five.

Q. 154. You have referred to some sketches in your notebook dealing with the development of the flywheel of the sound head. Can you state whether that notebook contains notes of all of your experiments in connection with this matter?

A. No, it does not. It contains only part of the notes we made on our experimental work.

Q. 155. I hand you this notebook again with some cards in it, some slips with some data on it, and ask you if you know what those are?

A. Those are still exposures in order to check up the fineness of the optical slit arrangement. I notice

that the width of the optical slit—that is, the width of the focal line on the film, is in several of the paper strips given a figure of .014 millimeters. That is about one-half of a mil in your units. That shows that at that time we used already a very fine line of light for recording purposes.

Q. 156. Do you know on what date those slips were made?

A. About April, 1921.

MR. NEAVE: Is he referring to his notebook in giving that answer?

THE WITNESS: Yes.

Q. 157. Are those some of the original slips you had at that time, or are those reproductions?

A. Those are original slips.

Q. 158. It has been in your notebook all along, or have you gotten them from somewhere else?

A. They have been in the notebook all the time.

Q. 159. Will you pick out just one or two of those, showing just typical slips that you used at that time, that we can put in evidence?

A. For instance this one.

Q. 160. Typical images of slips?

A. This one is marked "glow light 83." Current through the glow lamp 10 milliamperes. The focal distance, 36 millimeters. The physical slits which were used were three different physical slits having the size of .1, .5 and 1.0 millimeters. The width of the optical image of the slit on the paper strip is marked .019, .0194 and .018 millimeters. I have picked out one which doesn't give the finest line.

MR. WARD: I offer in evidence the slip that the witness has been testifying about from his notebook as Plaintiffs' Exhibit 25.

(Received in evidence and marked Plaintiffs' Exhibit 25.)

Q. 161. Doctor, I do not believe that I have asked you yet as to the quality of the sound reproduced by the type of machine illustrated in Exhibits 23 and 24, when those machines were used in Germany, which I understand by your testimony was in the year 1924 or 1925?

A. The performance of these machines was very good. We obtained very good production of speech and music through that machine, either of single instruments or of a full orchestra or of singing voices, and apparently the public was very much satisfied with the impression they got from the shows.

Q. 162. Now, can you state, if you know, why it was that after these twenty odd machines were installed in various cities of Germany in 1924 or 1925, why it was that it did not continue, or have the operation of those machines continued?

A. It seemed not possible at that time, probably due to the financial difficulties in Germany, to obtain capital for recording sufficient new subjects, so we just had to stop when we had shown our films in a number of German theatres. Of course, we could not go on indefinitely showing the same subjects in theatres.

Q. 164. Will you please state whether there were any people in Germany engaged during this time in the production of sound picture films which the theatres could be supplied with?

A. No. I don't know of any at that time.

Q. 165. Where did you have to get the films that you had shown in these machines?

A. We had to record the films ourselves, in our studio.

Q. 166. In addition to having to construct the machines you people had to maintain a laboratory to put out these films?

A. Yes, we had. And I like to add here that we were inventors capable of dealing with producing new

machines and new methods, but not so capable of starting a film producing business, and we had the impression at that time that the motion picture people were not so pleased in seeing something totally new introduced into their usual plan of working and proceeding.

Q. 167. Is it a matter relatively inexpensive or quite expensive to operate these studios for turning out the sound pictures?

A. It is a matter of quite large expenses to run a studio on an elaborate scale where you have to pay for actors and have to pay for building the stages and so on and have to pay for current lighting the stage.

Q. 168. Were any of you experienced in that line of the business?

A. No, none of my friends and I neither have any experience in producing motion picture films. We were just able to show that the new thing was possible and what could be done with it, and that studio business was more than anyone could have expected from us as we being only physicists and inventors and no film business people.

Q. 169. Can you state about how many so-called sound on film sound picture features or reels, I suppose they call them, you were able to get out in your laboratory to show in these theatres before you had to stop?

A. I think at the beginning we were able to give a show of about two and a half hours' length without any pauses between the different reels. The program consisted of a number of different—of the showing of a number of different musical instruments, and in a second piece entitled "A Day On a Farm," we showed quite a number of noises made by animals and by all kinds of appliances, cows and horses and so on on a farm; in a third picture we reproduced a shortened review of an opera of Mozart, "The Magic Flute"; in

a third one, we had a number of operas—long opera scenes, for instance one from Pagliacci and one from another Mozart opera. That is what just happens to come back to my memory.

Q. 169. To get an approximate idea of the number of the films that you put out, about how many would you say, before you stopped, that you put out for the public, roughly speaking?

A. Roughly speaking, I might say that we were able to give three shows, three different shows; that is, three shows filling a normal theatre evening.

Q. 170. That is, you mean enough of the subjects to supply three separate shows in any one theatre?

A. Yes, without repeating.

Q. 172. Now, did you make any effort to endeavor to obtain the interest of someone in running these studios to produce subjects?

A. Yes, we did.

Q. 173. Just state briefly what the result of that was?

A. In the year 1923 we met a Swiss attorney with the name of Doctor Curti. He got interested very much in the new inventions, and he finally was able to develop interest in several Swiss merchants, and the whole thing ended in the establishing of a new company called Tri-Ergon, A. G., Zurich. This Tri-Ergon, A. G., Zurich, was a patent holding company; it didn't make new films, but tried to sell the patent licenses or the patents outright. They succeeded in selling patents for the United States, for instance.

Q. 174. Well, we needn't go into that. I just want to bring out, Doctor, whether they undertook to go into the studio business.

A. No, they did not.

Q. 175. Did you bring one of your machines over to America, Doctor?

A. Yes, I did.

Q. 176. And if so, when?

A. I did in the year nineteen—end of year 1926.

Q. 177. And will you state where that machine was demonstrated, and at whose request it was brought over?

A. That machine was demonstrated—pardon me?

Q. 178. At whose request it was brought over and where it was demonstrated?

A. It has been brought over by request of Mr. William Fox, and was demonstrated at the place of the Fox Film Corporation, New York City.

Q. 179. Will you please state about how long that machine was here demonstrated?

A. I went over myself together with a machine, to show it to Mr. Fox, and I had several times opportunity to show him the films I brought with me. As I arrived here, I found the situation that the Western Electric Company apparently had got in connection with Mr. William Fox too, and it is my wish to point out here that the Western Electric Company had full access to all—to the shows and to the machines and as a matter of fact, a committee has been built during the time of my stay in the United States, a committee consisting of several directors of the Western Electric Company research scientists and of people of the Fox Case Corporation.

Q. 180. You referred to the fact that the Western Electric Company had opportunity to fully study your machine and observe it and so forth. Will you please state who from the Western Electric Company had this opportunity?

A. I remember distinctly Dr. Crandall, who is dead now; and Mr. Drake, of the Western Electric Company. We met several times and I explained to full extent all the inventions involved in the patents and our methods of recording and reproducing.

Q. 181. Did these parties have an opportunity to observe your machine?

A. Yes, they had.

Q. 182. Did you say anything to them about your system and ideas and machines or what, what happened about it? Did you only show them the machine or did you go into any details of the situation?

A. They had the possibility of being present at different shows, and then, as I tried to explain before, we met in committee meetings and at that time they had opportunity to get all details on our methods. As a matter of fact, I explained all the ways we used in recording, the advantages or disadvantages of different systems, the experiences we had in recording and the reason why we did it this way and not in another way; so that anything I knew at that time this committee had knowledge of.

Q. 183. Did you have similar opportunity to study the Western Electric so-called system at that time?

A. No, I don't think so. I was present once or twice at a reproduction and I remember that was at some time at the end of my visit in your country. But I certainly had no possibility of learning any details of the methods of their way of recording or reproducing.

Q. 184. Will you please state roughly approximately how many patents you and your two colleagues have taken out in this general art as a result of your investigations?

A. We took out about two hundred and fifty patents in the different countries of the world, and I think about twenty or twenty-five in the United States.

Q. 185. Doctor, reference has been made here to a German patent application filed by you and your colleagues on May 22d, 1920, which is in evidence as Exhibit 3. Will you please look at the drawings of that

application and glance at the specification, if you are not already familiar with it.

A. Yes, I remember this patent application very well.

Q. 186. Now, with respect to the date when you commenced your development work of the flywheel up in the sound head, with respect to that work, will you state when that application there was filed?

A. When we found out that we could not get constancy enough from the arrangement we had used up to the date of the patent application, we conceived at that time the idea of applying a heavy weighty mass, a flywheel, at the translating point—that is the point where the light is impinging on the film, or where the light is illuminating the film and falling on the PE cell. When we had the first crude idea about the importance of applying a flywheel, we rushed to the German Patent Office and made an application. And some weeks after having made the application we experimented with all kinds of arrangements, as I have tried to explain by referring to my laboratory notes. And as a matter of fact, the arrangements showed in this patent application.

Q. 187. That is, Exhibit 3?

A. Figure 1 of Exhibit 3. And Figure 2 of the drawings shows a way of applying a flywheel which has not been tried at all after the patent application has been made, because we decided that the way of doing it as the figures show here would be of no use. Here in the Figure 1 the film is touching the rollers of the flywheel only in a very narrow line; it is not bent over a part of the periphery of a roller. The same is true for Figure 2, and I tried to show, referring to my laboratory notes, some time ago, that that is a very important point, and in our actual experiments we decided very quickly to do it the other way.

Q. 189. Will you state—I am not sure you quite clearly brought it out—state whether the application was filed before or after you had undertaken any actual work on the problem of applying the flywheel up at the sound head?

A. Yes. I stated that as soon as we had got the idea in our minds that a flywheel had to be used, we made a—drew up a specification and applied for a patent, without having made any experiments, at that time. Experiments have been made in the time following this patent application, as can be seen from the dates I was able to give of the laboratory notes.

Q. 191. In your opinion, Doctor, is the apparatus shown in the drawings of that application, Exhibit 3, a practical operative device?

A. No, it is not. It would not operate, in the way it is shown here, in the patent application and the drawings.

Q. 192. Will you state briefly why that is so?

A. Because the application says, and the drawings show, that the film is moving in a straight linear direction, in a straight direction, and the energy of motion is supplied to the flywheel only by the roller of the flywheel touching the film in a tangential line. Now, it is impossible to keep the film by these means in a steady motion of constant speed which we desire.

Q. 193. I show you a copy of a United States Patent 1,587,786, and ask you if you can state what that relates to, in general?

A. This copy relates to means for amplifying weak currents, especially an improved amplifying tube which has one or more auxiliary grids additional to the standard control grid of an amplifying tube. The idea being in this patent that the potential of the auxiliary grid keeps the potential on the anode from changing, and so keeps the characteristic curve of the amplifying tube from being shifted to different grid bias values.

Q. 194. Is that one of the inventions of you and your colleagues?

A. Yes. I would like to explain here that we used already in the year 1922, when we made our first public demonstrations, for instance, in the Alhambra Theatre, that we used at that time an amplifying tube with three grids, a grid having the property of a screen grid, and a grid between cathode and control grid. These tubes had more or less the same working properties as the tubes used now very generally in receiving sets having the name of pentodes, and giving very high amplification. We were able to reproduce with a very good volume with an amplifying arrangement having only two stages, at the time of 1922.

Q. 195. I show you a copy of a patent, Exhibit 7, Patent No. 1,590,185, and ask you to state briefly what that is.

A. This is a patent on the combination of three elements, for instance, in the reproduction of a sound film. The main idea of the patent is the following one: A photoelectric cell should be used in reproduction which has its maximum of sensitivity at a wave length where the light-source illuminating the cell through the film emits a maximum of light-energy and at the same time the film modulating the light should have an absorptive property of being most absorptive for the rays emitted by the light-source. I know that nowadays the photoelectric cells for sound reproduction are selected so that their response is highest to the wave lengths at the maximum of the light-output of the light-source. This idea we had already at that time and applied for a patent.

Q. 196. At what time?

A. In Germany, December 22d, 1919.

Q. 197. Was that used or not used in your work around 1922 and 1923?

A. It was used partially at the time where we had for reproduction an arc light and a potassium photoelectric cell. The potassium photoelectric cells respond mostly for blue light, and the maximum of emission of an arc light is near the blue wave length range.

Mr. Ward: I would like to mark in evidence, as Plaintiffs' Exhibit No. 26, a copy of the U. S. Patent No. 1,587,786 referred to by the witness in his testimony.

And I would like to offer in evidence the photostats marked for identification as 17, 18, 19 and 19-A during Dr. Engl's testimony and one of them during Dr. Holborn's testimony.

(Various photostats introduced during Dr. Engl's direct examination, received in evidence, and marked respectively Plaintiff's Exhibits 17, 18, 19 and 19-A.)

(A copy of U. S. Patent No. 1,587,786 was received and marked in evidence as Plaintiffs' Exhibit No. 26.)

Direct Examination (Continued).

By Mr. Ward:

Q. 198. Dr. Engl, when I questioned you about the machine shown in Exhibits 23 and 24, being, as I understand, the final type of machine that you built in Germany, I asked you if the motor driving that machine was the same as you used in Germany, and you pointed out that it was not the same, and then you called my attention since to the fact that I did not ask you what other differences there were in that machine shown in these photographs 23 and 24—any differences from the machine as it was originally constructed in Germany. I now hand you the Exhibits 23 and 24 and ask you if you will point out on those photographs of that final

type of machine any other changes shown on that photograph which were different from the machine as it stood in Germany when you had it built in 1924 or 1925, I believe it was.

A. Those two photographs relate to one machine, as I see it, and, except the fact I mentioned yesterday of being a small difference in the arrangement of the driving motor, there is no difference in the machine compared with the lot of twenty-five we manufactured and I told you about yesterday, and there is no difference compared with the machine I brought over with me. I might explain more in detail about the running of the film through the machine, if that is necessary.

Q. 199. Just explain the difference in that construction there that you pointed out to me.

A. The difference in the construction is only that there has been added a gear box. Apparently the motor driving this machine here has another number of revolutions per minute than the original motor I brought with me and, to adjust the running speed of the machine, a gear box has been added to cut it down or raise the speed. I don't know whether the number of revolutions of the motor is higher or lower than it was with my electric motor I brought with me.

Q. 200. Now, this photograph I pointed out yesterday has a spring connection between the motor and the machine?

A. Yes, it has, and the machine I brought with me has a spring connection.

Q. 201. What, if anything, was done with regard to the sprocket on the sound head over which the film passed, to take care of the standard width of sprocket used in the United States?

A. The sprocket wheel showed in the photograph here has been cut——

Q. 202. Is it marked?

A. Yes, it is marked 3. It has been cut so that only one series of sprockets remains. When you are using standard film with a sprocket wheel in the condition the photograph shows, the standard film will overhang the sprocket wheel so that the light can go freely through the sound track.

Q. 203. How is the sprocket cut, longitudinally with the axis, or transversely of the axis?

A. Transversely to the axis.

Q. 204. That was to separate the two parts of the sprocket? I doubt if you can see from the picture; it is covered by the film.

A. Yes; it had been done to be able to throw the light through the film; otherwise the sprocket wheel would be in the way of the light.

Q. 205. That is, to enable the light to go through the film and through the two parts of the sprocket on to the PE cell?

A. Exactly.

Q. 206. Will you please state whether the arrangement of the photo cell inside the sprocket there is the same arrangement or different from the way you had it in the machine in Germany?

A. The arrangement of the photoelectric cell is about the same. There is only a slight difference in so far as the photoelectric cell is pushed in a little farther in the interior of the sprocket wheel, because with standard film the sound track is a little farther in, located a little farther in.

Q. 207. That is, in the German machine the sound track was on the outside in line with the PE cell; whereas, in the standard film, since the sound track was near the center of the sprocket transversely, this PE cell was pushed in to line it up with the slot in the sprocket?

A. Yes.

Q. 208. Does that make any difference at all in the principle of operation?

A. No, it does not make any difference.

Q. 209. Now, I hand you a sheet of paper numbered pages 72 and 73, and ask you what the two figures 44 and 45 on those sheets illustrate, if you know.

A. The first figure, 44, gives an illustration of the machine for reproducing.

Q. 210. What machine, Doctor?

A. A machine of the same type as I have just seen on the photographs.

Q. 211. The same as shown in the photographs, Exhibits 23 and 24?

A. Yes.

Q. 212. Now, those photographs that you now have in your hand, or those figures, represent the machine as it stood at what time?

A. They represent the machine as it was in the year 1925 or 1926, when the building of these machines had been completed.

Q. 213. Does it represent the machine as you brought it here at the end of 1926, or were changes made in it at the time that you brought it over here in 1926?

A. No, I don't know of any changes made.

MR. WARD: I offer in evidence the two figures the witness has referred to, Figures 44 and 45, as Plaintiffs' Exhibit 27-A and 27-B, respectively.

(Received in evidence and marked Plaintiffs' Exhibits 27-A and 27-B, respectively.)

Q. 214. So a comparison of the photographs, Exhibits 23 and 24, with the cuts of the machine, Exhibits 27-A and 27-B, will show, as far as cuts will show, the differences in the machine as it now stands

and as the machine stood when you had it built and brought it to America in 1926?

A. Yes, sir.

Q. 215. There is a numeral 1 on Figure 45. Will you please state what that numeral 1 designates?

A. That numeral 1 indicates the PE cell in that picture.

Q. 216. And the sprocket that drives the film there, at what position is that with respect to that PE cell?

A. The axis of the PE cell is identical with the axis of the driving shaft on which the sprocket wheel is fastened.

Q. 217. Now, will you please indicate on Figure 44, the flywheel on that machine.

A. There is already an arrow made with a pencil showing the letter F.

Q. 218. Does the lead line from that letter run to the flywheel?

A. I think it does. Yes. I might add here that it possible in looking at Figure 44 to see the spring connection between the motor and the main driving shaft which we referred to a few minutes ago.

Q. 219. Now, Doctor, with respect to the arrangement for supporting and moving the film through both of those machines shown in Exhibits 23 and 24 and 27-A and 27-B, will you please state whether the arrangement is as illustrated in any of the figures of the patent in suit and, if so, which figures.

A. Figures 3 and 4 of the patent you gave me illustrates an arrangement which is identical with the picture 44 on Exhibit 27-A.

Q. 220. Now, with respect to the fact that in those machines the flywheel was driven by a spring, which of the patent figures does that construction correspond to, if any?

A. The driving of the flywheel with a resilient means, a spring, is shown in Figures 5 and 6 in the patent you gave me.

Q. 221. I think I neglected, Doctor, to ask you which figures of the patent, if any, with respect to the film support and drive, correspond to the machine shown in Exhibit 17.

A. The same figures, 5 and 6, of the patent you just gave me, correspond to the arrangement shown in Exhibit 17.

Q. 223. Is there any difference in the drive and support of the film in Exhibit 17 from that that you have testified to in Exhibits 23 and 24 and 27?

A. No, there is no difference in the driving arrangement. The only difference, to repeat it, is the position of the sound track and the position of the PE cell in relation to the sound track.

Q. 224. You testified yesterday as to the quality of the sound reproduction in Germany by the machines that you exhibited in private demonstrations to the scientists. I think I failed to ask you what was the quality of the reproduction on the machines as shown in Exhibits 27-A and 27-B.

A. The quality of the projection with those machines was as good, if not better, than with the machine shown in Exhibit 17.

Q. 225. Well, was the quality good or bad?

A. It was very good. I might point out that sibilants in speech could be heard very well, and the constancy was very good, it was not possible to detect any change in pitch of music. We were able to reproduce, for instance, a piano record too, which is the most sensitive instrument for recording—if the pitch is not absolutely—if the speed of a machine either in recording or reproducing is not absolutely constant, you will detect it very quickly in listening to a piano record.

Q. 226. And with reference to the machine that you brought over here to New York at the end of 1926 and stated that you demonstrated to the Fox-Case and the Western Electric people early in 1927, I believe; what was the quality of the sound reproduction that you gave at that time?

A. The quality was very good. The films I brought with me showed a number of different subjects—speech, single voices, musical instruments, a number of musical instruments of different kinds, and all kind of noises made by machines or animals, and so on. And the reproduction of all those sounds I considered very good.

Q. 226. Now, you informed me last night that you made an error in giving an answer yesterday which you said was to the effect that you had seen or heard a demonstration of sound on film given by Western Electric Company or with Western Electric Company apparatus, toward the latter part of your stay here in 1927. Will you please state what you want to say in regard to correcting that.

A. I wish to correct myself in so far as I have not heard any reproduction of sound films made with a Western Electric system or through a Western Electric reproducing machine. What I alluded to yesterday was a one or two shows given with a Fox—with a Movietone system, and the films of the show had been recorded, as I was instructed at that time, by the Movietone system too. So I had no opportunity to hear anything of the Western Electric machines.

Q. 227. You did not see any of the machines that recorded it?

A. No, I did not. They were not shown to me.

Q. 228. Did you see any of the apparatus of the machines that reproduced the show that you saw?

A. No, I did not.

Q. 229. So all you know about the demonstration is that it was one given by the Movietone?

A. Yes.

CROSS-EXAMINATION.

By MR. NEAVE:

XQ. 230. Are you the Josef Engl who, in connection with others, applied for the patent in suit?

A. Yes, I am.

XQ. 231. In your direct testimony you spoke of Mr. William Fox. Do you know him personally?

A. Yes, I know him personally.

XQ. 232. And you have had deals with him?

A. Pardon me?

XQ. 233. You have had dealings with him from time to time?

A. I have a contract and—rather, I am an employee of his for a certain part of work which I do over in Germany, developing new things, and so on.

XQ. 234. Developing new things in the sound recording and reproduction?

A. In the sound recording part.

XQ. 235. And how long have you had that contract with him—or a contract with him—to do work of that character?

A. Since, I think, 1930.

XQ. 236. Who is Mr. William Fox?

A. I couldn't give you any details about his personality.

XQ. 237. Well, I don't so much mean his personality, but what is his occupation and what are his business relations and what connections has he?

A. I couldn't tell you anything about it. He never told me anything that.

XQ. 238. Do you know that he is connected with the American Tri-Ergon Company?

A. I know that he acquired the patent rights.

XQ. 239. And you know that he is president of the American Tri-Ergon Corporation?

A. I don't know anything about that.

XQ. 240. You don't know that he is connected with that corporation in any way?

A. Not as a fact.

XQ. 241. You have never written to him as president of that corporation?

A. Never.

MR. WARD: Your Honor, I object to that line of questions. I am willing to stipulate that Mr. Fox has a controlling interest in the American Tri-Ergon Company.

MR. NEAVE: That is, the plaintiff, the plaintiff company.

MR. WARD: Yes.

XQ. 242. When did you come to this country on this present trip?

A. I arrived last week, Wednesday.

XQ. 243. Who asked you to come, Mr. Fox?

A. No, I received a cable signed by Mr. Joy.

XQ. 244. Mr. Joy. Did you come in pursuance of your contract with Mr. Fox?

A. That is true.

XQ. 245. Are you still associated with Mr. Vogt and Mr. Massolle?

A. No, I am not.

XQ. 246. When was that association discontinued?

A. I think the association with my two friends was discontinued in so far as we did not invent things—I don't know whether to express it as "conjointly," whether that is the expression—in the year 1927.

XQ. 247. That is, you stopped working together at that time?

A. Yes.

XQ. 248. You stopped working with both of them at that time?

A. All three of us stopped working together.

XQ. 249. When did you begin working together, you three?

A. 1918.

XQ. 250. Is that what you describe as early in the fall of 1918?

A. Yes, the beginning of our co-operation was different with my two friends. Mr. Vogt and myself worked together, I think, since the summer of 1918, and a few months later on Mr. Massolle joined us.

XQ. 251. How long had you known Mr. Vogt prior to the summer of 1918?

MR. WARD: I object to that as irrelevant and immaterial, your Honor. We will be here all summer if this keeps up.

MR. NEAVE: I had a purpose in that question, your Honor.

THE COURT: You do not have to reveal your purpose on cross-examination. I will allow the question with an exception to the plaintiff.

A. About, I think, one or two years prior to 1918.

XQ. 252. Did you first meet him after you had graduated from Goettingen or before?

A. After.

XQ. 253. And at the time when you met him, you were with the Siemens & Halske Company?

A. Yes.

XQ. 254. And what was he doing at the time that you met him? What was his occupation?

A. He developed instruments for the so-called streamline underground telephony work.

XQ. 255. When did you first meet Mr. Massolle?

A. I met him first in the fall of 1918.

XQ. 256. But you and Mr. Vogt, as I understand it, began working together before Mr. Massolle joined you. At whose suggestion or at whose initiation did you two begin working together? You and Mr. Vogt?

A. We did not work together in a general view idea. I could not give an answer to this question because it is too generally put.

XQ. 257. As I understand it, you and Mr. Vogt began working together in the summer of 1918.

A. Working together on a certain subject, of course.

XQ. 258. And what was that subject?

A. The subject was developing of sound recording, sound picture recording and reproducing.

XQ. 259. How did you happen to come together? Did he come to you or did you go to him?

A. We just met, as I remember it.

XQ. 260. Well, you had met for a year or two off and on prior to that time, had you?

A. Pardon me?

XQ. 261. You had met Mr. Vogt at various times for a year or two prior to the summer of 1918?

A. Yes.

XQ. 262. And you had not been working with him until the summer of 1918?

A. No, we met privately.

XQ. 263. I beg your pardon?

A. We met privately as people who knew one another.

XQ. 264. When did you meet him other than privately? When did you meet him in business relations? That was in the summer of 1918?

A. I would not call that a business relation. We discussed subjects interesting us both, quite a number of times and, during those discussions, we probably came to the subject of sound picture recording too.

XQ. 265. Who brought up the subject; you or Mr. Vogt?

A. As far as I remember, it went in the following way. Mr. Vogt, during one of our discussions, said that he had the idea that it might be a good plan to try to develop something new because it was about the time when the war was nearing its end, and I remember at another meeting of us he told me that some years before he read and studied about the experiments of Ruhmer, and then he began to discuss, just not in a very thorough way, but just touchingly—I don't know whether that word is good English—the subject.

XQ. 266. I suppose that should be casually instead of touchingly?

A. Yes. We tried to find out which way would be better than the way Mr. Ruhmer was going at his time.

XQ. 267. Then you and he began working together in the summer of 1918; that is right, is it?

A. Yes.

XQ. 268. And how did you do that? Were you still with the Siemens & Halske at that time?

A. At that time I was still with Siemens & Halske.

XQ. 269. And Mr. Vogt at that time had another occupation?

A. Yes.

XQ. 270. And did each of you give up your occupation at that time and take up work together?

A. I gave up my occupation at that time, yes.

XQ. 271. And did Mr. Vogt give up his previous occupation?

A. He did too, yes.

XQ. 272. And both of you, having resigned from the connections that existed prior, you came together to do some work. Where did you do the work?

A. At which place?

XQ. 273. Yes.

A. Now, of course, some months were gone by at that moment. Our work consisted mainly in finding out new ways. I mean it was not such very thorough laboratory work. We had, as a matter of fact, in the beginning of 1919, not a definite laboratory place. The first laboratory we had was, I think, about April or May, 1919.

XQ. 274. From the middle of the summer of 1918 until Mr. Massolle joined you, did you and Mr. Vogt have offices together somewhere?

A. No, we had not.

XQ. 275. Where would you meet and have your talks?

A. In our homes.

XQ. 276. In your homes?

A. Yes.

XQ. 277. Prior to the summer of 1918 had you ever had anything to do with sound recording and reproduction?

A. No, I had not. I had to do with photoelectric cells, because I made quite a number of scientific investigations and I had to do with glow light discharge phenomena.

XQ. 278. That was before the summer of 1918?

A. Yes.

XQ. 279. And had Mr. Vogt, so far as you know, any experience or done any work on sound recording and reproducing?

A. No, I think Mr. Vogt was about in the same position as I was.

XQ. 280. Prior to the summer of 1918 you had been doing work on the photoelectric cell?

A. Yes.

XQ. 281. In what connection? While you were with the Siemens & Halske Company?

A. Even before that.

XQ. 282. What work did you do on the photoelectric cell?

A. I built photoelectric cells and studied their properties, made different kinds of arrangements of the electrodes. As far as I remember, I studied at that time the relationship between illumination and currents. And so on.

XQ. 283. Had the photoelectric cell, as you then knew it, worked pretty well?

A. I did not test it.

XQ. 284. Did not test it?

A. I did not test it for sound work at that time.

XQ. 285. What kind of work were you testing it and using it for?

A. It was just a scientific investigation.

XQ. 286. And on the glow lamp too, was that work of the same character?

A. Yes.

XQ. 287. Mr. Massolle joined you when; in the fall of 1918?

A. In the fall of 1918.

XQ. 288. And how did he happen to come along and join you?

A. He was an old acquaintance of Mr. Vogt's during the war. He became acquainted at some place, I think it was in Kiel, where they worked together on radio problems.

XQ. 289. How did he happen to join you? Did Mr. Vogt ask him to come and join you in the work?

A. He asked whether it would be all right with me if Massolle joined us because he thought that his experience in radio telephony and high frequency work would come in very handy.

XQ. 290. And so far as you know, had Mr. Massolle had any experience in sound recording and reproducing prior to the time he joined you in the fall of 1918?

A. As far as I know, not.

XQ. 291. After he had joined you, did you three then have any offices together, or did you keep meeting around at your houses?

A. We had our first offices together in April or May, 1919.

XQ. 292. When Mr. Massolle joined you did he give up his previous occupation?

A. Yes, he did.

XQ. 293. Then you three, Mr. Vogt and you and Mr. Massolle, devoted all of your time to this work together?

A. Yes, we did.

XQ. 294. And who was paying you anything at that time?

A. At that time nobody was paying us.

XQ. 295. You had some expenses, didn't you?

A. Yes, we had.

XQ. 296. And who paid those?

A. We.

XQ. 297. In what proportions? How were those expenses shared?

A. You mean expenses for laboratory work?

XQ. 299. No, I mean the expenses during the fall of 1918. You had some expenses, didn't you, then?

A. We had not very large expenses, because we started our real experimental work on a larger scale, as I told—I think I told—when we had our offices, and that was April or May, 1919.

XQ. 300. Well, then, the larger expenses began then?

A. Yes.

XQ. 301. Now, were those expenses shared between you three?

A. We found some people who we could make interested in this whole possibility.

XQ. 302. And they put up some money?

A. They put up some money.

XQ. 303. Did you and Mr. Vogt and Mr. Massolle have any written agreement between you as to the carrying on of this work?

A. No, we had not.

XQ. 304. Did you have any understanding between you as to the carrying on of this work?

A. Yes.

XQ. 305. That each of you would devote all of your time to the work?

A. Yes.

XQ. 306. And as to the results of the work, what was the agreement between you?

A. We would consider ourselves equivalent in all the respects.

XQ. 307. That is, you were equal partners in the enterprise?

A. Yes.

XQ. 308. Is that what you mean?

A. Yes.

XQ. 309. And what was the arrangement between you as to how any inventions that might be made should be held: would you have equal shares in any inventions made?

A. Pardon me. I didn't understand the last.

XQ. 310. Suppose that some inventions were made: was it your understanding that each of you three would have an equal interest in any of the inventions made?

A. We knew very soon that as the whole future of our inventions depended on the co-operation, that it was impossible to decide in each and every case who, the percentage of inventing work of the individuals; so we didn't go into this matter at all, but agreed upon the following: that we considered in all the matters we found out us three, as equal inventors.

XQ. 311. Then first you three had offices together, and then you got a laboratory a little later?

A. Yes.

XQ. 312. Where was that laboratory?

A. It was in Berlin, Wilmersdorf.

XQ. 313. Was that one you established for your own work?

A. Yes.

XQ. 314. Was a Mr. Seibt there with you?

A. No.

XQ. 315. How long did you have that laboratory of your own?

A. Oh, we had it at that place, I think, for three or four years. And after having our laboratory for two years at Wilmersdorf, we added a larger workshop in the southeast of Berlin, at the place mentioned yesterday during the testimony of Dr. Holborn, in the Kopernicher Strasse.

XQ. 316. And you equipped this laboratory with the necessary apparatus and had employees under you, did you, working with you?

A. Yes, we had.

XQ. 317. And that was all paid for by these backers that you spoke of who were putting up the money?

A. Exactly.

XQ. 319. You testified yesterday that—now I am quoting: "Our principal idea from the beginning was to use means for recording and reproducing which had no inertia," end of quote; which of you three suggested the idea of doing work on recording and reproducing sound? That, as I understand your testimony, came up first, in your talk with Mr. Vogt during the summer of 1918. Now, you established then your laboratory later. And who was it that conducted that work on that sound recording and reproducing?

A. We three.

XQ. 320. Who was it that proposed to use a glow light discharge?

A. As I told you, we three.

XQ. 321. All just suddenly, altogether at once?

A. About the thing. That was about what happened.

XQ. 322. You had previously done work on glow lamps, hadn't you?

A. Yes, I had.

XQ. 323. Had the others?

A. Not that I know of.

XQ. 324. So that before starting to try a glow lamp you waited for Mr. Vogt to suggest a glow lamp?

A. You see, it was in the following way: we had maybe met and discussed how we might proceed best and, during the course of this discussion, the different parties of this inventor combination said different things. But we made it a point that we didn't keep any record of who said anything first, because we did not want to introduce any fight about inventorship; the priorities, amongst ourselves. That was the reason that we called the whole thing Tri-Ergon, which means "work of three."

XQ. 325. When did you begin calling the whole thing Tri-Ergon?

A. When we appeared before the public; it was probably the year 1921.

XQ. 326. You had not used that term prior to that time?

A. We did not.

XQ. 327. Now, who worked on the glow discharge, after you three got together, who did the work?

A. I personally manufactured a number of different glow discharge tubes.

XQ. 328. And tested them?

A. And tested them conjointly.

XQ. 329. All three of you?

A. It was impossible, you see, to do a work of this kind as a single man. Every day we worked together. We were in the same room, or at least in rooms being very near one another.

XQ. 330. Yes, but one or the other of you might initiate some work or initiate an idea, I suppose?

A. Yes.

XQ. 331. And who initiated the idea of using photoelectric cell?

A. It was exactly the same thing as I tried to explain about the glow discharge.

XQ. 332. That is, you would all agree that you would not have any jealousies among yourselves by attempting to pick out the one person doing one part of the work and another person doing another part?

A. Yes.

XQ. 333. Did you work on photoelectric cells?

A. I personally?

XQ. 334. Yes.

A. Yes, I did. I made photoelectric cells.

XQ. 335. And did the others work on photoelectric cells?

A. They did, but they did not manufacture any of them.

XQ. 336. Now, you three gentlemen, you and Mr. Vogt and Mr. Massolle, have in your three names filed applications for about, well, filed about 350 applications here and abroad, haven't you?

A. Yes.

XQ. 337. Did you ever apply for any patent relating to sound recording and reproducing in your own name prior to 1928?

A. Prior to which year, please?

XQ. 338. The reason I say 1928 is because I have one of your German patents that is applied for in your own name at that date. But I could not find any earlier one.

A. Yes, I applied for that patent, that is right. But that was after we discontinued our co-operation.

XQ. 339. I do not find any application filed by you alone of a prior date. Do you know of any earlier application that you alone filed?

A. Yes. When I was here the first time in the United States, it was very urgent to apply for an American patent. And I think this American patent had been applied for only in my name; but I am not sure.

XQ. 340. In what year was that? That is, when?

A. In 1924, probably.

XQ. 341. Nineteen what?

A. 1924.

XQ. 342. '24?

A. But I am not sure about this. It might be so.

XQ. 343. What did that relate to, do you remember?

A. I could not tell you.

XQ. 344. And you are not sure whether you applied for it in your own name, or whether it was done in the names of you three?

A. I am not sure about that. But that is the only case I remember.

XQ. 345. I am sorry, but I have forgotten; when did you say your co-operation with these two other men ended?

A. I think I said the year 1926 or 1927. I am not—if you want an exact year I have to think it over.

XQ. 346. No, that is near enough, as far as I am concerned. Now, you and Mr. Vogt began working together in the summer of 1918 and Mr. Massolle joined you in the fall of 1918. At the time Mr. Massolle joined you how far had you and Mr. Vogt gotten on your work on sound recording and reproducing?

A. We had not gone as far as to be able to apply for any patents at that time.

XQ. 347. Did you build any apparatus or have any apparatus built?

A. I think we were only able to purchase some apparatus which we intended to use; but we did not make any special arrangement of apparatus for that purpose.

XQ. 348. Look at the drawings of the patent in suit here, will you, and tell me which of the things that are there in those drawings were talked over by you and Mr. Vogt before Mr. Massolle joined you?

A. No, certainly not.

XQ. 349. None of those parts?

A. No.

XQ. 350. Then what was it that you and Mr. Vogt discussed before Mr. Massolle joined you?

A. In general our way of proceeding with this kind of problem, that is, trying to find appliances for the recording and—I mean microphone and a transmitting system, a recording system, and the same thing in reproducing, which were as a first fact without any inertia.

XQ. 351. That is, you talked about using a glow light then or some inertialess light of some sort?

A. We put that up as the principle which we wanted to follow through in all of our work, you see.

XQ. 352. You had been doing work on glow lights before then? You brought to Mr. Vogt's attention then the use of a glow light?

A. Maybe I did.

XQ. 353. You had been doing work on photoelectric cells. You brought to his attention the use of a photoelectric cell, didn't you?

A. Maybe I did.

XQ. 354. Well, did you?

A. It is very difficult to remember that now, after we have been going through all of this work of experimenting.

XQ. 355. Of course, during those months you must have been talking about something, and I suppose you would have been discussing with each other what you had had of prior experiences?

A. Yes. I remember, for instance, that Vogt told me of some experiences with steel wires and steel ribbons.

XQ. 356. Steel wires and ribbons on which sound had been recorded magnetically?

A. Yes, sir. He had a possibility once, I think, to test apparatus, using this kind of an arrangement.

XQ. 357. That is, he had tested such apparatus, or you were talking of testing such apparatus?

A. I think he had at one time—I don't remember exactly when—he had an opportunity of looking at this kind of machine and trying it out.

XQ. 358. And did you and he discuss the use of photographic films?

A. Yes.

XQ. 359. For sound?

A. Yes, we did.

XQ. 360. That was before Mr. Massolle joined you?

A. As I understand—I have to give you facts.

XQ. 361. Do the best you can.

A. I cannot give an answer, an exact answer to that.

XQ. 362. Now, in taking out and in applying for these numerous patents that you and Mr. Vogt and Mr. Massolle have applied for in your three names, I notice that sometimes the names appear in one order and sometimes in another order. For instance, in German Patent No. 417,967, I see that the application was filed by Mr. Vogt, you and Massolle—in that order. Whereas, in the German Patent No. 387,058, the order was: Vogt, Massolle and you. And in Patent No. 389,-317, 389,318 and 389,319, the order was: Massolle, Vogt

and you. What was the reason for these changes in the order?

A. I could not give you an exact reason for that.

XQ. 364. Did you ever hear it talked of as to any particular order in which the names were to appear?

A. No.

XQ. 366. Will you look at Exhibit 9. That is your and your associates' application in Germany for a patent on the photoelectric cell, isn't it?

A. Yes.

XQ. 367. And it is upon that application that Patent No. 417,967 issued in Germany?

A. Yes.

XQ. 368. And you know, do you not, that that patent on the photoelectric cell, German Patent No. 417,967, was held invalid in the Nullity Court in Germany?

A. I don't know. I am interested in physics and inventions but not in patents and patent suits and so forth. So I could not tell you anything about it. As a matter of fact, I really don't know anything about it.

XQ. 369. You know you have an application pending here for the photoelectric cell, haven't you?

A. Yes, I think I have, because we applied in the United States for a number of subjects.

XQ. 370. And you testified, did you not, in the interference proceedings after they had gotten into court under Section 4915, if that means anything to you.

A. No, it does not.

XQ. 371. In September, 1930, you testified, didn't you?

A. Yes, I was in Washington.

XQ. 372. You testified here yesterday with reference to a German application which is in this case Exhibit 3, and it is upon that application that this

German Patent No. 387,058 issued, isn't it? Please see whether they correspond.

A. Yes.

XQ. 373. That is a flywheel patent you were speaking of—Excuse me, you were speaking of the application upon which that patent issued. You said that the apparatus shown in that application, which is the same as that shown in the patent, would be of no use as it would not be practically operative, it being impossible to keep the film in a steady motion of constant speed. Did you ever try that apparatus as a basis for this statement of yours?

A. We concluded from all of our experimental insight that it was—that the application had been made on a wrong basis because, as I tried to explain here, the roller carrying the flywheel is touching the film only in an infinitesimal line, and tangential, and it is impossible to have the same speed at the place of the film as at the place of the periphery of the roller. There is not enough coupling between them.

XQ. 374. You mean there would be a slip between them?

A. Yes, sir; not even a constant slip, but an intermittent slip.

XQ. 375. The film is there squeezed between two rollers?

A. Yes.

XQ. 376. Instead of being wrapped around one of the rollers, in whole or in part?

A. Yes.

XQ. 377. And your criticism applies to both Figures 1 and 2?

A. Yes, it does.

XQ. 378. Have you ever tried that apparatus?

A. No, we did not as a matter of fact. As I explained, we tried the other arrangement where the film is wrapped a certain amount.

XQ. 379. But you never tried the construction of this application of Exhibit 3?

A. No.

XQ. 380. And the other arrangement that you tried was what?

A. It was an arrangement which is shown in the other patent application.

XQ. 381. With the film partially going around a portion of one of the rollers?

A. Yes, sir.

XQ. 382. Then where would you have your object lens? Where would be your place of the point of translation?

A. I would have to go back to the drawings of the other patent.

XQ. 383. Here are the three applications, Exhibits 4, 5 and 6.

A. For instance, in this figure here, of Exhibit 5, the lights are applied on a part of the film which overhangs the portion of the roller or roller member over which the film is wrapped. And here in Exhibit 4, Figure 2, you have it arranged in the same way, overhanging of the film. In Figure 1 you might do it different ways, either by having the film overhang the cylindrical member, or by having an opening in the cylindrical member.

XQ. 384. If you were recording instead of reproducing, you would not have to have this overhang, would you?

A. Not necessarily, because no light has to go through the film then.

XQ. 385. When did you discover that the arrangements of Figures 1 and 2 of your application, Exhibit No. 3, and your resultant Patent 387,058, was not very good?

A. A short time after we applied for the patent.

XQ. 386. And by saying it was of no use and was not a practical operative device, and so forth, you mean that it is not commercially operative to give constant speed?

A. No. I just mean to say that we did not even think of that, we thought it so inoperative that we did not think of making experiments with this kind of arrangement.

XQ. 387. That is, it might do some good but not enough to make it worth while?

A. In order to decide about this question, I have to make experiments, you see.

XQ. 388. Which you never have done?

A. No.

XQ. 389. And of course it is true, is it not, that no flywheel can result in giving you absolutely uniform speed: it only approximates to it, is that right?

A. That depends on what is meant with absoluteness.

XQ. 390. Well, by absolute I mean absolute. You can't get absolutely uniform speed?

A. That for the human mind you are absolutely not able to detect anything different.

XQ. 391. Can you, by the flywheel, make the speed so nearly constant that you cannot detect any departure from constancy?

A. Yes, of course. It depends, of course, on the means of detecting.

XQ. 392. With some means you can always detect a variation of the constancy?

A. No, it is just like an affair of battleships and guns. It means sometimes the guns are stronger and sometimes the armour of the battleship. It is a fight between both means.

XQ. 393. In testing your apparatus from time to time, to see whether you have gotten a constant speed, what means did you use?

A. We at the first place recorded a constant source of frequency. We had an A. C. generator, generating alternating voltage by magnetic means or by a tube arrangement. We checked the constancy of these speeds by, for instance, arranging a beating device. Then we made a record of this frequency. Then we checked up this constancy of speed of the record, either by running it in the machine again and beating again against the constant frequency, or by measuring the distances of the individual variations, the maximums of variations with a very high powered microscope and a measuring arrangement on that microscope.

XQ. 394. And then the record that you made, this constant note, did you listen to that note, as reproduced in your machine?

A. Yes, we did.

XQ. 395. And then tried to detect in your ear whether there was any beating or anything of that sort?

A. Yes.

XQ. 396. And you did not hear any beating at all?

A. No, we did not, when all was in good working shape. Sometimes we heard, then we had to find out the trouble.

XQ. 397. Now, when that application, Exhibit No. 3, corresponding with the patent that you have in your hand, was filed, who owned it: you and Mr. Massolle and Mr. Vogt?

A. Yes.

XQ. 398. And you know, don't you, that while that application was pending in the Patent Office there was opposition to it being issued?

A. I don't know.

XQ. 399. Did you take any part in that?

A. I don't know anything about that.

XQ. 400. And don't you know that the patent was granted in spite of that opposition and that thereafter there were proceedings in the Nullity Court to cancel that patent, and the patent was not cancelled, the Nullity Court decided in your favor, don't you?

A. I don't know anything about that.

XQ. 401. Now, speaking of that application, Exhibit No. 3, which resulted in the German patent that you have before you, you testified that, quote, "We conceived at that time the idea of applying a heavy weighty mass, a flywheel, at the translating point; that is, the point where the light is impinging on the film" —end of quote—and that, quote, "When we had the first crude idea about the importance of applying the flywheel, we rushed to the Patent Office and made an application," end of quote.

A. Yes.

XQ. 402. And that was the application, Exhibit No. 3, resulting in the patent before you, was it not?

A. Yes.

XQ. 403. That is, you filed that application before the idea had been worked out at all?

A. Yes.

XQ. 404. So at the time the application was filed, the thing was nothing more than just an idea?

A. Yes.

XQ. 405. Now, from whom did you hear the first statement of the idea that a flywheel should be applied at that point?

A. Do you mean from somebody outside, or at——

XQ. 406. From whom did you hear it? Did you suggest it first or did Mr. Vogt suggest it?

A. We three inventors suggested it.

XQ. 407. That is, some morning you three came into the office and simultaneously you all said that would be a good thing; is that it?

A. No.

XQ. 408. That couldn't be it, of course, Doctor?

A. No, that would not have happened this way. But we discussed the matter and the result of our discussion was that we thought it a good idea to apply to a flywheel to the dangerous point—as I put it yesterday.

XQ. 409. And who was it that suggested the applying of a flywheel at that point?

A. It is impossible for me to tell you anything about that because, you see, we came together every day during a number of years, and discussed every day things relating to our work, and it is really impossible to remember who said that first or other things.

XQ. 410. And from the beginning you had agreed you would not have any such discussions?

A. Yes.

XQ. 411. Now, will you look at that Patent 387,058 that you have before you, issued on application Exhibit No. 3, and look upon the underscored sentence, which is the first full sentence on the first column of the second page. You look at the German of that, while I read my translation of it, and I am going to ask you whether my translation is correct. As I am informed, that sentence that I have underlined is properly translated as follows: "The rollers bringing about the uniform speed can also be used directly at the control place for the guiding of the sound band." End of quote. Is that a correct translation?

A. I think so, yes.

XQ. 412. Now, what does that mean with reference to the drawing?

A. You see, in the drawing the translating point is always at some distance from the rollers which carry it—or rather, one of which carries the flywheel. And it suggested here in the sentence you just translated into the English language that these rollers might be applied at the translating point.

XQ. 414. Draw me a sketch of what you meant by that sentence at that time, at the time when the sentence was written.

A. (Witness draws a sketch.)

XQ. 415. In this sketch which you have now made, you have introduced the idea of the film overhang outside the edge of the rollers, haven't you?

A. Well, that depends. The patent description does not say anything about it, so these rollers might be made out of glass, as far as I know. In the light of what we made later on, I might have here an arrangement where the film overhangs. But I think that in this case the arrangement would be more inoperative, because then the tangential line along which the pressure rollers are touching the film is still shorter, so that you have less pressure and the whole thing will work worse than before.

XQ. 418. And then this sketch that you have made introduces the idea of an overhang or a glass roller, is that it?

A. That is what strikes my mind just now. Maybe I might find out a third thing.

XQ. 419. Now, at that time when you filed that application you had not an overhang in mind, had you?

A. Pardon me?

XQ. 420. You had no overhang in mind at the time when you made that application, I presume?

A. I do not know anything about what I had; I really cannot remember what I had in mind at the day I filed this application, that being thirteen years ago.

XQ. 421. That is, you cannot now recall what it was that you intended to convey by the sentence which we have translated; is that it?

A. No, that is not it.

XQ. 422. Well, then, what did you intend to convey by that sentence?

A. The sentence was intended to say that quite naturally that it seemed not necessary to have the translating point at a distance from the point where the flywheel is coupled to the film. It says, "It is possible to arrange so that these pressure rollers—these rollers can be applied in the neighborhood—very much in the neighborhood of the translating point."

XQ. 423. My translation is, "Can be used directly at the control point."

A. Yes, that is better.

XQ. 424. I suppose there is no difference to that?

A. Yes.

XQ. 425. Now, that control point, that is, the point of translation, can be directly on a roller surface, can it not, so far as recording is concerned, as distinguished from reproducing—because the light does not have to shine, then, through the film?

A. Yes, but there are two rollers here. It has to go through one of them at least.

XQ. 426. Well, why not bend that film around one of those rollers and then have the light imagine—have the objective that focuses the image on the film bearing right down on the surface of the film?

A. But I cannot—you asked me to illustrate this sentence with a new figure. I cannot make a totally different figure, then I have made a new invention here.

MR. NEAVE: I ask that it be marked for identification, the sketch wihch the witness made.

(Marked Defendants' Exhibit A for identification.)

XQ. 427. Now, I show you a very rough sketch of my own.

A. Yes.

XQ. 428. Does not that sketch illustrate what is described in the sentence that we have been translating?

A. No. In my opinion, it introduces a third moment here, which seems to me very important. And if I continue in introducing new parts, then I can change the sketch over to any arrangement.

XQ. 429. Yes, but in your sketch you have introduced new parts, that is an overhang or a glass roller, haven't you?

A. Yes, I told you before that I am bound to, when you wish me to make a sketch.

XQ. 430. Now, my sketch is no more a departure and is just as——

A. Oh, yes; it is.

XQ. 431. Why?

A. It is a departure by two steps. Now, you not only—you took the same step I did, in so far as you put the translating point to the coupling point, and you took a second step.

XQ. 432. As you did. You took a second step, in making an overhang or a glass roller. I took a second step——

A. I had to do, otherwise the thing would not work at all; anybody would see that.

XQ. 433. And so I had to, too.

A. You do it with my knowledge, now.

XQ. 434. And your overhang is with your knowledge now, as distinguished from your knowledge at that time?

A. Yes, but you see there is a difference in what we did. The overhang is not necessary—a necessity; but this is a necessity.

MR. NEAVE: I ask that there be marked for identification the sketch handed to the witness by me.

(Marked Defendants' Exhibit B for identification.)

XQ. 435. Now, when did you or your associate first make a sound projector embodying a flywheel?

A. Embodying a flywheel quite generally?

XQ. 436. Yes.

A. The first projector, or rather, reproducing machine, I might say, was the framework 1, I showed yesterday, Exhibit number—I don't know the number.

XQ. 437. I don't know, Doctor, is it one of these?

A. Yes. Exhibit 18.

XQ. 438. Exhibits 19 and 18?

A. Yes.

XQ. 439. Is this flywheel there?

A. There is a flywheel there.

XQ. 440. Where is it with reference to the point of translation?

A. The point of translation is here.

XQ. 441. It is the point marked A?

A. It is marked No. 1.

XQ. 442. On Exhibit 18?

A. Yes. These two are not flywheels. They are magazines or reels.

XQ. 443. I see. The film is run this way, from this magazine over an idler roller here, over this cylindrical member, past the translating point, over a sprocket wheel having on its shaft a flywheel.

XQ. 444. That shaft is marked what?

A. Marked 2. And then into the upper reel.

XQ. 445. Thank you very much. In building that first machine with that flywheel on it, how was the flywheel designed as to size and weight and moment of inertia? Did you sit down and design it and figure out the proper design and the moment of inertia for that flywheel?

A. No, we did not figure it out. We just put on a heavy flywheel to try it out.

XQ. 446. And did it help?

A. Yes, it helped, but not with the desired result.

XQ. 447. What was the matter with it?

A. The speed was not yet constant enough.

XQ. 448. Even though you had a flywheel on there?

A. Yes.

XQ. 449. But it helped?

A. It helped.

XQ. 450. And the next machine, what did you do to make the flywheel help more?

A. We put it nearer the dangerous point, that is, nearer the translation point.

XQ. 451. Did you put it directly at the point of translation? Did that help more?

A. I beg your pardon. We did not put it directly at the translation point. We put it nearer. Sometimes we put it directly at the translation point and sometimes in the vicinity of that.

XQ. 452. Have you got any picture here of that second machine? That next machine where you say you put it nearer but not at the translation point? Is this it, **Exhibit 19-A**?

A. Yes.

XQ. 453. There was a flywheel on that—two flywheels, weren't there?

A. Not always. Sometimes. We always, as I remember, put a flywheel on that shaft No. 1, but not always on No. 2.

XQ. 454. In designing that flywheel, did you figure out the moment of inertia on that?

A. Yes, we did. I remember we considered the speed, the number of revolutions and, as a matter of fact, we made it as high as possible in the beginning.

XQ. 455. You mean you made the speed as high as possible?

A. The moment of inertia.

XQ. 456. The moment of inertia as high as possible?

A. Yes.

XQ. 457. Of course, "as high as possible" would mean a larger and larger wheel as you pass further and further from the axis?

A. I mean as large as possible within the possibilities here.

XQ. 458. That is, the larger the moment of inertia the better you are off?

A. Yes. That is true to a certain extent. You can go too far and then you get so large momentum of the flywheel that it might do anything. If it has a certain speed and you shut off the motor, it might destroy something, some gears.

XQ. 459. But so long as it is running, your constancy of speed is the better the higher the moment of the inertia of the flywheel?

A. Yes.

XQ. 460. In the patent in suit what is the effect of the flywheel? It is that it provides inertia so as to carry the moving part, the moving shaft, and the things connected with it, over little periods when there is not any impelling force, or where there are some disturbing forces. Isn't that right? It smoothes out the things?

A. Yes.

XQ. 461. How is that effect different from that which is always produced by a flywheel?

A. I do not quite understand you.

XQ. 462. How is that effect any different from that which is always produced by any flywheel?

A. First we have to consider here that in a sound on film recording and reproducing arrangement, you have a member of very little mass, which is the film, and you couple to this little mass a very large mass. I believe that is the main characteristic feature of the proposition here, if you might distinguish it from any other use of flywheels.

XQ. 463. The flywheel giving constant rate of rotation, acts just as it always did, doesn't it?

A. It acts just as what?

XQ. 464. As it always does in any relation.

A. No, I would not say that.

XQ. 465. You and your associates did not discover any new properties of flywheels, did you?

A. No, we did not, but I might say that in the case of this arrangement it is quite another proposition compared with a flywheel in an ordinary piece of machinery, because human ears are very sensitive against change, against very small changes in pitch,—that is, in the speed of the record, and changes which not be of any importance in another type of machine.

XQ. 466. Well, you mean it is a very good thing to use in this kind of machine?

A. Not alone that. For instance, you have to take care of the flywheel here, which we found out by actual experiments and did not appreciate before, that we had to check it up, not only statically but dynamically. We had to see that the thing, when it was rotating around an axis, had no unevenness around its periphery at all. And not only unevenness in size, but in weight, or rather in mass.

XQ. 467. It had to be a good flywheel?

A. It had to be a rotating mass which had equal moments of inertia all around the rotating axis.

XQ. 468. Now, before some one of you suggested the idea of using a flywheel in this relation, you were familiar, were you not, with motion picture projectors?

A. Yes, to some extent.

XQ. 469. You knew that in one type of those projectors where the film moves intermittently, it should move with a constant intermittency—if I may so express it—that is, the times of intermittent motion should be equally spaced, uniformly. You knew that, didn't you?

A. Yes.

XQ. 470. And you knew that in those projectors there was a constantly uniformly rotating shaft that acted upon the intermittent mechanism?

A. Yes.

XQ. 471. And you knew that on that constantly uniformly rotating shaft there was a flywheel, didn't you?

A. No.

XQ. 472. You did not know that?

A. No. As a matter of fact, the constructions I just happened to remember, the German constructions, there is not used any flywheel at this place you are mentioning.

XQ. 473. Were you familiar with the form of motion picture projectors in which there was no intermittent motion, but the film moved continuously?

A. I knew something about it, but at that time, you are speaking of the time around 1920, I guess. At that time I did not care very much for this type of projector because it was just in the state of beginning.

XQ. 474. You have since known of both of those types of projector, haven't you?

A. Yes.

XQ. 475. And you have since known that there are flywheels used in both of those types of projectors?

A. I could not say that a flywheel is used, for instance, speaking of the Mechau projector. As I remember, the Mechau projector is such a heavy construction with heavy weights at a distance almost a foot from the rotating axis, that you do not need any flywheel at all. The thing itself has a very heavy momentum.

XQ. 476. It is a flywheel by its own construction?

A. You might call it so if you want to.

XQ. 477. The other types of machine, intermittently moving motion picture projector, you now know

that a flywheel was used in giving to the shaft a constant uniform rate of rotation?

A. As a matter of fact, I saw the first flywheel in the intermittent movement of a projecting machine by the construction of the Powers people, which I saw first in 1927, I think.

XQ. 478. And the flywheel in that projector was used *for the same purpose which the flywheel in your* apparatus was used, was it not, in that it was to assist in giving to the shaft a constant uniform rotation?

A. No, I would not think that you can compare a piece of machinery where you have intermittent motion, with a piece of machinery where you are taking care to avoid any irregularity.

XQ. 479. The shaft on which the flywheel was, was not to have an intermittent motion, was it?

A. Of what are you speaking now?

XQ. 480. Of that Powers machine.

A. I don't know on which shaft the flywheel was. I just happened to remember now quite a good sized flywheel on the Powers machine.

XQ. 481. Do you recognize this that I hand you as the flywheel and shaft and intermittent motion of the Powers machine you are referring to?

A. Yes, I think that is it.

XQ. 482. That is what you recognize?

A. Yes, I think so.

XQ. 483. And you now have your hand on the flywheel and are turning it and the shaft with it. And that shaft on which the flywheel is, was to have a constant uniform rate of rotation, wasn't it? That, was the idea?

A. I don't know what is the idea with this kind of construction, because I do not see why this shaft should be rotating with a uniform speed compared with the necessity for uniform speed in a sound reproducing machine.

XQ. 484. If it is not rotating at a uniform speed, you won't have your intermittent motion taking place at regular spaced intervals, would you?

A. May I add to my answer? I do know now what the idea is. To overcome the possibility of the intermittent movement being locked in a dead position. You know, in all of these kinds of movements, you find dead positions, where the thing is locked, just as in a steam engine, and exactly the same thing applies here as in a steam engine. In a steam engine you have a flywheel to overcome and to check the dead position.

THE COURT: Dead center?

THE WITNESS: Yes. And the same thing applies here.

XQ. 485. May I ask you this. This may be a repetition, but I want to be sure that we have it right. It is true, is it not, that in the motion picture projectors, in order to get a good effect, you want the intermittent motion of the film, if it is of the intermittent type, to occur at regular intervals and not at irregular intervals?

A. I cannot admit that.

XQ. 486. It is better to have them occur at irregular intervals?

A. But it does not matter. You would not be able to detect it with your eyes if you changed from 24 pictures to 22 pictures per second. You would not see any difference upon the screen.

XQ. 487. Let us assume, although you do not seem to agree, that it is desirable that the intermittent operation should take place at uniform intervals. The flywheel of the shaft of this Powers machine, the shaft driving the intermittent part, the flywheel will assist in giving those regular spacings.

A. I don't know. How shall I give an answer to a proposition which I do not agree with?

XQ. 488. Let me put it this way: In this Powers machine the flywheel of the constantly rotating shaft will tend to act to make the intervals between the intermittent motions more uniform, will it not?

A. Yes. But I would like to repeat here again that that is not necessary for motion picture projecting. What is necessary is that a picture on the screen is absolutely at rest; otherwise, you have a flicker and your eyes get tired, but the periodicity of the pictures, I mean the intervals at which the pictures appear on the screen, has no importance at all for a good reproduction.

XQ. 489. How much experience have you had with picture projection?

A. Quite a lot. Because in the course of my work I had to supervise quite a lot of projecting.

XQ. 490. But your attention was directed more to the sound?

A. No. I even had to rig up myself with my own hands a projector and adjust it.

MR. NEAVE: I ask that this piece of the Powers machine be marked for identification.

(Marked Defendants' Exhibit C for Identification.)

XQ. 491. Your German application, Exhibit 6, which resulted in Patent No. 389,317, was for a resilient connection between the driving member and the flywheel, wasn't it?

A. Yes.

XQ. 492. Who suggested the resilient connection with the fixed stops there?

A. I think I have to give the same answer as I did before, that we three inventors conjointly suggested this arrangement.

XQ. 493. Do you really mean that, Doctor, or do you mean that you three agreed that you would not pick out which of you had done it?

A. My real meaning is that I could not tell you now exactly which one of us might have said the first word about it.

XQ. 494. And the reason why you cannot tell me is because it was established between you that that was a matter of no importance?

A. Yes.

XQ. 495. And should not be discussed?

A. Yes.

XQ. 496. Look at your application, which is marked Exhibit 4, resulting in Patent No. 389,318, which has in it Figures 1 and 2 of the patent in suit. Can you tell me who suggested the use of these sprockets $r_1$ and $r_2$ in Figure 2?

A. No.

XQ. 497. Who suggested the use of these rollers $dr_1$ and $dr_2$?

A. No.

XQ. 498. And you cannot with reference to any feature?

A. No, certainly not.

XQ. 499. And your answer is the same with reference to your application, Exhibit 5, resulting in Patent No. 389,319?

A. Yes, I have to give the same answer.

XQ. 500. During this time, beginning in the spring of 1919, when you and Mr. Vogt and Mr. Massolle were working together, all of you were devoting all of your time to that work, were you?

A. Yes.

XQ. 501. And anything that any of you did in that period belonged to the joint enterprise?

A. Yes.

XQ. 502. Did you during that period work on X-ray apparatus?

A. No, I did not.

XQ. 503. I show you a patent, German Patent No. 386,334, one in which the application was filed in February, 1923. That was the time when you three were working together?

A. Yes.

XQ. 504. That is an application by you alone?

A. Oh, yes; I remember that.

XQ. 505. How do you explain that?

A. I remember that some idea struck my mind that it might be possible to measure the intensity of X-ray with the PE cell in the same way as you measure the intensity of light, and I spoke of that with my two friends about it, and they thought it of no importance for our work and told me to go ahead and apply for a patent if I liked to.

XQ. 506. Without their permission you could not have gone ahead and applied for a patent in your own name?

A. I would not call it permission, but it was a gentlemen's agreement that nobody of us would do a thing of that kind.

XQ. 507. The application for the patent in suit was executed by you and Mr. Vogt and Mr. Massolle in March, 1922. Were you at that time familiar with United States laws as to who are entitled to apply for patents?

A. No. Because we did not apply for any United States patent at that time, and it was furthermore a matter for our patent attorney to take care of.

XQ. 508. Well, this time, March, 1922, is when you did apply for this United States patent in suit. That revises your previous answer, doesn't it?

A. Yes, I have to answer about the same. We did not care at all about it. We just gave our patent attor-

ney the material for the patent application and he was to do all what he considered necessary.

XQ. 509. Was any inquiry made of you at or prior to that time as to who made the alleged invention?

A. What is that?

XQ. 510. Was any inquiry made of you at that time as to who made this alleged invention?

A. No.

XQ. 511. Was there any correspondence or discussion as to who should sign the application as inventors?

A. We signed them all three conjointly, as far as I remember.

XQ. 512. That is right—you did. At the time of swearing to the application did you read the oath which you signed?

A. Yes, I read that oath, I think.

XQ. 513. In that oath occurs the sentence: "That they verily believe themselves to be the original, first and joint inventors," and so forth. Did you read that, the words "joint inventors"?

A. Probably I did.

XQ. 514. What did you understand those words "joint inventors" to mean?

A. I think I understood that it meant inventors which joined their possibilities and helped one another to invent something, as we did actually in our case.

XQ. 515. But still you cannot tell me which features were proposed or conceived or invented by which one of you?

A. No.

XQ. 516. And when you read those words in that oath, you did not ask your lawyers or anybody just what had to be the state of facts in order that your oath might be true?

A. No. As I remember, I thought it just meant the situation as it actually was with our inventing.

XQ. 517. I think you said that you made your films because the commercial ones were not accurate enough in the size or spacing of the sprocket holes to give sufficient constancy of motion. Did I understand you correctly?

A. That we did not make the film?

XQ. 518. You did make it?

A. No. We perforated the film.

XQ. 519. I beg your pardon. That is what I meant. You perforated your films because the commercial ones were not accurate enough to give you constancy of motion?

A. Yes.

XQ. 520. How long did you continue to do that perforating of your films?

A. I think we began to perforate our own film—Let me see—in the year 1922, probably, or 1923, I am not sure about it, and continued till 1926, around.

XQ. 521. And you continued then to perforate your film so as to get constancy of motion, even after you began using flywheels?

A. Yes.

XQ. 522. That means, then, that the flywheel in itself was not sufficient to give you contancy?

A. No, it wouldn't mean anything of that. You see, when we once started in using a certain type of perforation hole, we had to stick to it, because using another type again would mean changing all the sprockets and sprocket wheels and so on, and all the recording, and printing, reproducing machines, which of course we didn't care to do.

XQ. 523. And unless the perforations in your film were regularly spaced to fit the sprockets, you would have a lack of constancy of motion even though you used a flywheel, isn't that true?

A. If there was a certain looseness or if the perforation distance was not coincident with the distance

of the sprocket teeth, you couldn't have any constancy of speed.

XQ. 524. Even though you used a flywheel?

A. Yes.

XQ. 526. Where did you get your sound projectors?

A. Which sound projectors?

XQ. 527. Any of them?

A. The first sound projectors we built ourselves, in our own workshop.

XQ. 528. And you bought them some time later from other people?

A. No. We had a lot of twenty-five I spoke about yesterday. We did the following: we got in connection with the Krupp-Ernemann people known as manufacturers of picture projectors, and made an arrangement with them so that they manufactured for us the mechanical parts of our sound picture reproducing machines. We gave them the blueprints and they delivered the apparatus.

XQ. 529. You produced a short piece of film yesterday, which is marked Complainant's Exhibit 25. That was made, as I understand, in 1923?

A. Yes.

XQ. 530. How much of that film have you here? Have you a long reel of it here?

A. I personally have nothing at all.

Mr. Neave: May I ask, Mr. Ward, whether you have more of this?

Mr. Ward: I don't know a thing about it, Mr. Neave.

Mr. Neave: Somebody must.

Mr. Ward: Mr. Haselton, I think, gave me that piece.

Mr. Neave: Mr. Haselton, have you a lot more?

MR. HASELTON: I don't know of any, no.

XQ. 531. Did you bring this piece here?

A. No. No.

XQ. 532. How did you recognize it?

A. Because there is a picture on it which I recognize.

XQ. 533. But I might have made that yesterday, Doctor.

A. Oh, no. Nobody in this country does make any —as far as I know—this type of perforation and this type of sound record, and it would be a very strange coincidence if somebody would have made it.

XQ. 534. Who gave it to you?

A. Mr. Ward yesterday.

MR. NEAVE: May I ask, Mr. Ward, where you got it?

MR. WARD: I got it from Mr. Haselton.

MR. NEAVE: Mr. Haselton, may I ask where you got it?

MR. HASELTON: From Mr. Joy.

MR. WARD: We can prove the source of it if you wish, if that is what you want.

MR. NEAVE: I want some more of it. Has Mr. Joy any more of it here? That is, what I would like would be it; I would like to have some of that film to examine and test.

MR. WARD: Mr. Joy will go on the stand later on, I think, if you want to do that.

MR. NEAVE: But I want to test it before I examine Mr. Joy. So I request that I be allowed to have some of that film for examination and test, today.

THE COURT: You gentlemen will supply him, if possible.

MR. WARD: Your Honor, the film he is talking about, if it is in existence I don't know.

MR. NEAVE: You can ask Mr. Joy.

MR. WARD: I don't see what right at all he has to it. Nothing has been put in evidence here about it, the piece was supposed to be put in evidence to illustrate the type, the contour of the sprocket perforations. I don't see what right Mr. Neave has to get anything that has not been put in evidence and does not relate to the situation.

MR. NEAVE: You put in evidence a piece of film.

MR. WARD: Exactly.

MR. NEAVE: And I would like some of that film to examine.

MR. WARD: Well, they can give you a piece to examine if they have got it there.

MR. NEAVE: I may destroy it in examining it. So I can't take the original. And I request some more of it.

XQ. 536. Now, let us look at Exhibit 24, which is a photograph, as I understand it, of one of your machines. I suppose that it is the flywheel the left edge of which I see just below the dark motor?

A. Yes.

XQ. 537. And on the face of the flywheel it is noticed, as we look at the photograph, there is an arm standing out to the left almost horizontally, and then seems to be connected with a spring to the flywheel; is that right?

A. That is right.

XQ. 538. And that is a spiral spring?

A. Yes, it is a spiral spring.

XQ. 539. I do not see that there are stops there, are there?

A. Yes, there are stops. Probably on the other side of this. There is the second stop on the other side.

XQ. 540. Does that work all right?

A. Yes.

XQ. 541. Did you make any calculations to determine how strong that spring should be?

A. Yes.

XQ. 542. And how strong was it to be? I do not mean in pounds. But it would be strong enough to give what result?

A. It was to be strong enough to just keep this lever here in the intermediate place between the stops.

XQ. 543. That is, it ought not to touch either of the stops except in starting or stopping?

A. Exactly.

XQ. 544. Now, didn't that introduce oscillations into your rotations, and oscillations into the movement of the film?

A. I remember that it introduced some oscillation at the beginning of our experiments with that.

XQ. 545. And how did you prevent those oscillations in the film?

A. We had to take a certain type of spring, of a certain resiliency, and then we did away with this oscillations.

XQ. 546. Merely by getting a spring of a different resiliency?

A. Yes. The momentum of inertia of the flywheel, together with the resiliency of the spring, and of course together with the internal friction in the material of the spring, and the friction of the bearings represented a certain resonant frequency of the whole filtering system.

XQ. 547. Then an unintelligent person such as I would not get along at all well by just using a flywheel

and putting a spring in, would I? I might introduce more variations, instead of wiping them out, wouldn't I?

A. Yes, but I think that you very soon would try different springs and probably would find the right one.

XQ. 548. Well, there is nothing in your patent in suit, is there, that gives any warning in that regard, or tells me how to use a spring so that I won't increase the speed variations rather than diminish them?

A. I have to look at the patent to tell you about that.

(Printed copy of a patent handed to witness.)

THE WITNESS: It says here: "This spring can be very feeble, as at constant speed it has to overcome only the losses from friction of the driven part." It gives a figure for the resiliency of the spring, rather, not in terms of figures, but in terms of what it has to accomplish; that is, you can find out very quickly which spring is the right one.

XQ. 549. So that if I, in building one of these pieces of apparatus, take a spring of such a strength that when the device is in operation the arm will be between the stops not touching either of them, I have got the right resiliency; is that it?

A. Exactly. The arm when you are running the machine.

XQ. 550. When I am running them, yes. And if I get that I won't get an increase in oscillation due to the spring action; is that it?

A. I would not say that. It might be that you happen to have an arrangement where you have no friction at all in the bearings. Then the dampening factor of the whole filter arrangement would be very low. And it might be that you get some oscillations there.

XQ. 551. So in order to get no oscillations, you have to have some damping arrangement, as they call it, have you?

A. Yes.

XQ. 552. And that is not in the patent, is it?

A. Yes.

XQ. 553. Where?

A. It speaks about the losses of friction from the driven part.

XQ. 554. How much losses by friction?

A. It does not say anything about it, because it is not necessary to do it.

XQ. 555. And if there is only a slight friction, you will not have enough damping, will you?

A. Yes, but you will have a certain reasonable amount of friction in any—if you built a shaft and bearings of this size and type, you have a reasonable amount of friction all the time. I mean, there can be a little, somewhat more or less, but on the average it is about the same.

XQ. 556. Then why, in your first work with the resilient connection, did you find that you had introduced oscillations, instead of removing them?

A. Probably we had a very strong spring in it.

XQ. 557. Well, in your very first ones you had a spring which, when the apparatus was running at a normal speed, held the arm between the stops and not on the stops, didn't it?

A. No, certainly not. We just took any spring and began with trying, and found out, in the course of the experiments, what we had to do.

XQ. 558. In the first spring that you made or you used, the spring was not of such force as to keep the arm off the stops in normal running?

A. I mean the following: when the spring is very strong, the stops may be touched. If you decrease the strength of the spring, the stops may be touched no more. But the lever may be very near one of the stops, and as you decrease further on, the strength comes

farther away. Now, the best position will be when it is about in the middle between both stops.

XQ. 559. And when you started in this experimental work on these springs you had the strength of the spring such that in running its normal speed, the arm was about in the middle?

A. Yes.

XQ. 560. And it gave you oscillations; you had to change it and put in another spring, did you not?

A. No. Then we had reached the condition where we had no oscillation any more.

XQ. 561. So that on any given machine, if I arrange the strength of my spring so that when running at normal speed the arm does not touch either stop or is halfway between, I won't get oscillations as a result of the spring action; is that right?

A. I would not say in any type of machine, because I have not tested all the types of machines.

XQ. 562. You referred yesterday, in testifying to records for determining the consistency of speed. Do you remember?

A. Yes.

XQ. 563. How were those tests made?

A. You refer to the tests given in the notes given in this laboratory files?

XQ. 564. Yes.

A. These tests were made in the following way: in the framework No. 2, the film was run with an arrangement of flywheel, either on one sprocket shaft or on two and the film going around the cylindrical member sometimes or going around the second flywheel shaft, and a frequency was recorded, a constant frequency was recorded, a constant frequency.

XQ. 565. What frequency was that?

A. Different. From 50 or 100 up to several thousand. We checked up the constancy of this frequency

generator. The frequency had to be recorded, and then either the record was run again through the machine, and we listened to the beating of the sound produced by the record with a second source of sound, or the distances between the maximums of density were measured with a microscope and on a measuring bench, and checked whether the distances were all the same.

XQ. 566. The change in density merely indicated changes in loudness, did it not?

A. Yes. But it indicates too the maximum of the density—or rather, the distance between two maxima of density indicates the distance between two—I meant, put it—indicates the period of the variation, we call it.

XQ. 567. Can you tell me at what linear speed the film was run?

A. About thirty to forty or fifty centimeters. It was different in different experiments.

XQ. 568. Per second?

A. Per second.

XQ. 569. Doctor, I have here before me a photograph of a page of the supplement of the "Film Kurier," February 6th, 1932, and in it it appears that Mr. Vogt said:

> "In the entire sound picture suits which have heretofore been conducted and are still being conducted (above all in U. S. A.) among many hundreds of patents, three patents above all play a deciding role, and of which I can call myself the personal inventor:
>
> "The Patent No. 368,383 of April 14th, 1921, which protects the separate development.
>
> "The Patent No. 387,058 of May 22d, 1920, which has as its subject matter the uniform motion of the film.
>
> "The Patent No. 417,967 of March 3d, 1919, which protects the photoelectric cell and the inertialess source of the light."

There is more that is quoted from Mr. Vogt, but I will not read any more at present, and I show you the article in German. You are familiar with the fact that Mr. Vogt made such statements?

A. No, I am not.

XQ. 570. Have you ever seen that publication before?

A. No. (Reading.) I have read through that extract here.

XQ. 571. And you have never seen that before?

A. No.

XQ. 572. And never had that called to your attention?

A. No.

XQ. 573. What were your relations with Mr. Vogt at that date?

A. What year?

XQ. 574. February, 1932.

A. You are asking me about my relations with him?

XQ. 575. Yes, in 1932.

A. Just the relation as two friends may have. I had no business relations with him at all.

XQ. 576. Perfectly friendly relation?

A. I saw him comparatively seldom. Maybe three or four times a year, or something like that.

XQ. 577. Did you ever hear him state, apart from this publication, that he was the inventor of that German flywheel patent that we were discussing?

A. Never heard anything about it. This is the first time I see anything of that kind.

XQ. 578. Did Mr. Ward or any of his associates talk that over with you?

A. No.

XQ. 579. What have you to say as to Mr. Vogt's claim that he was the inventor of that German flywheel?

A. Personally I should say now that this is an abstract apparently of a letter written by Vogt. I don't know what these people in the newspaper have extracted. It says here, "In a longer important letter, Mr. Hans Vogt says the following, the letter which we cannot publish to its whole extent on account of not having enough space."

XQ. 580. And then they purport to say that he said that, at any rate?

A. Yes.

XQ. 581. Well, now, what have you to say as to his claim that he was the inventor?

A. I do not think that is the truth, what this newspaper says here. All I can say is that these inventions we spoke about were made conjointly by the three inventors.

XQ. 582. And at that time, in 1932, of course, your relations—your joint association, let me put it that way—with Vogt and Massolle had terminated?

A. Yes, it had terminated some years ago.

XQ. 583. And Vogt was no longer connected with Tri-Ergon matters?

A. I don't know of anything very definite about that.

XQ. 584. Do you know whether he was employed by William Fox after your association terminated?

A. Well, if Mr. Fox has been employed?

XQ. 585. Employed Mr. Vogt.

A. I do not know anything about that.

XQ. 586. You have been employed by Mr. Fox since that time, of course?

A. Yes.

XQ. 587. And haven't you been working in conjunction with others who were employed by Mr. Fox?

A. Never. That is, I worked together with Mr. Joy, and I understand that he is employed by Mr. Fox.

XQ. 588. Now, in this German flywheel application, Exhibit No. 3, reference is made to a governor. Do you remember that, a speed governor?

A. Yes, it says the shaft of roller $r_2$, respectively, m is connected with a revolution counter, not shown in the drawing, and a revolution regulator.

XQ. 589. What was the purpose of that governor?

A. The purpose of that governor is explained in the latter part of the sentence. It goes on: "Revolution regulator, both of which control the average reproducing speed by acting on the driving motor."

XQ. 590. That is, that was a supplemental means of getting nearer to uniformity of speed of motion of the film?

A. No. The idea of this regulator was to have a certain feet per minute number in reproducing, you see, so that you can check up whether they are reproducing with the same twenty-four pictures per second you use in recording—which is of course necessary.

XQ. 591. That is, it was to assist in regulating the motion of the film, was it?

A. Not the revolution counter, of course.

XQ. 592. No. The governor?

A. This regulator. But as I take it from this description, it did not take care of any of the irregularities in the speed. It only took care of the average running speed of the machine.

XQ. 593. And didn't that governor act as a flywheel?

A. No.

XQ. 594. Does not every governor act as a flywheel that has rotating balls?

A. Pardon me, I didn't understand you. A governor act as a flywheel?

XQ. 595. It does, doesn't it?

A. No, I don't think so.

XQ. 596. Doesn't it have to?

A. The governor would probably introduce, if you applied it at the same place as a flywheel it might introduce irregularities, it might introduce an oscillation.

XQ. 597. The governors with which I am familiar —you may have some other type in mind—are those which have some balls held on arms that may swing from the vertical to the horizontal, for instance, and when the speed goes higher and higher, the balls go up.

A. Yes, I know this type.

XQ. 598. And was that a type such as you had in mind in that patent?

A. I could not tell you which type we had in mind. That is just a general mentioning of those revolution counters and governors; as I explained several times, we did not think about how an actual arrangement, after the patent description, might be built. We just put down on paper a general idea which he had at that time in our minds, and then didn't think about at all.

XQ. 599. The type of governor that I have spoken of has a flywheel effect, has it not?

A. It certainly would not have the effect which you probably have in your mind.

XQ. 600. Well, I think it would. The effect that I have in my mind is that it is a rotating mass that has inertia and as it rotates it tends to make up, through its inertia, any irregularities in the rate of rotation of the shaft on which it is fixed.

A. I think the mass of a governor of that type is chosen somewhat low in order that it follows any change of the speed in order to again control the speed, so I would not say that it has an appreciable inertia. If it had an appreciable inertia, it would not follow any changes, you see. The idea of inertia being just to keep a certain physical state of speed or whatever it is.

XQ. 601. The question as to whether the ball of the governor will move up under increased speed is

not a question of the small changes, I take it, but of the speed of revolution?

A. Yes.

XQ. 602. Suppose the balls have moved up and out going at a certain speed; does not the mass of the balls in revolving at that speed necessarily have an inertia effect, a flywheel effect?

A. I certainly would not call that a flywheel effect.

XQ. 603. Whenever a mass is rotating it produces a flywheel effect, doesn't it?

A. Now, you would not call that a flywheel if I put a piece of gunshot on a thin thread and turned it around this way (illustrating). This is a mass——

XQ. 604. I will put it on a shaft. Suppose any mass having inertia attached to a shaft revolves around that shaft; it necessarily has a flywheel effect, hasn't it, if it is attached to that shaft? Not by a string?

A. No. For instance, if the shaft has a mass which is comparable to the attached mass you are speaking of, I would not say that a flywheel is constituted by attaching this mass to it.

XQ. 605. The shaft itself has a flywheel effect?

A. I do not think so, because the diameter of shafts you remember that the moment of inertia goes with the square of the distance from the axis. In a shaft you have very small distances from the axis.

XQ. 606. So it would not have so much flywheel effect. That is all you mean, isn't it?

A. Or none at all which might play any role here.

XQ. 607. Any mass that is outside of the line of the axis has a flywheel effect, hasn't it?

A. It has a moment of inertia, but I would not call it a flywheel. The expression "flywheel" means an effect which you can compare, an effect which actually stores kinetic energy to a certain amount.

XQ. 608. It has to be to a certain amount of kinetic energy stored in order to be a flywheel?

A. Sure.

XQ. 609. What amount?

A. The amount you might measure by considering the other moving parts of the machine. For instance, if you have a steam engine and take off the flywheel of the engine, you have still a rotating shaft but you would not say that there is a flywheel on the steam engine if you just took it off.

XQ. 610. You have taken off most of your flywheel effect, haven't you?

A. Yes.

XQ. 611. In the patent in suit you say that the rollers $r_1$ and $r_2$ of Figure 1 are "suitably coupled by gearing or belting." Figure 1 does not show either gearing or belting, does it?

A. Gearing or belting of what, if I may ask?

XQ. 612. It says here that the film strip moves over the rollers $r_1$ and $r_2$.

A. Yes.

XQ. 613. Suitably coupled by gearing or belting. Neither gearing nor belting is shown. That is right, isn't it?

A. No, it is not shown.

XQ. 614. How would you connect those two by gearing?

A. I might put an intermediate roller between both or between rollers on the same shafts carrying the rollers.

XQ. 615. You would put a gear on the shaft carrying $r_1$ and a gear on the shaft carrying $r_2$, and between those two gears you would put another gear into which those would mesh?

A. Not necessarily.

XQ. 616. How else would you do it?

A. It might be done by friction, for instance.

XQ. 617. By gearing you mean friction devices?

A. Yes.

XQ. 618. You don't mean gear teeth?

A. It could be done both ways.

XQ. 619. Suppose you do it by gears which are made up of spur gears: how would you do it?

A. Spur gears?

XQ. 620. Yes, ordinary spur tooth gears. You would put a gear on the shaft of $r_1$ and a gear on the shaft of $r_2$ and a gear between the two, into which the gears mesh?

A. Yes.

XQ. 621. All the shafts on the same line?

A. You mean in the same direction; not in the same line. Parallel?

XQ. 622. I was thinking all three shafts being parallel in the same plane.

A. Not necessarily in one plane.

XQ. 623. The effect would be the same whether all three were in the same plane or whether one was raised above the other; isn't that right?

A. Yes.

XQ. 624. Then if you connected gearing, if you connected those things with that gearing I have spoken of in that way, the thing would still work: is that it?

A. It will work, but it depends upon what you mean by "work".

XQ. 625. It would not work so well as if you used belting?

A. The influence of the gears might be very high and I might feel it and get variations of speed.

XQ. 626. The fact that you have $r_1$ and $r_2$ connected by gears does not prevent the flywheels from having their flywheel effect, does it?

A. No, they are still flywheels, of course.

XQ. 627. And have a flywheel effect?

A. That is a very general expression. I don't know what you mean by "flywheel effect". I am a physicist and cannot admit any generalities.

XQ. 628. Well, they still act as rotating masses, having moment of inertia and smooth out any inequalities or tend to smooth out inequalities in the rate of rotation of the shaft?

A. Yes, they tend to smooth out.

XQ. 629. Now, on Figure 1 of your patent, the roller $r_1$ or $r_2$ can itself be the rotating mass and act as a flywheel, can it not?

A. No, I don't think so, because there is a certain relation between the revolution numbers per minute of the roller and its diameter, that is, when the film is running at 90 per minute, which is considered as a standard speed, the standard revolution number per minute of the sprocket wheel is given when the diameter is given. When you increase the diameter of the sprocket wheel in order to get a flywheel effect, the revolution per minute, the revolution number per minute of this sprocket wheel will go down and the flywheel effect is again—you will get rid of the flywheel effect again.

XQ. 630. And what you are saying is also true of Figure 2, that the roller r cannot in itself be used to give the flywheel effect instead of using the mass m?

A. What I said is true for Figure 2 too.

XQ. 631. That is, you could not use the roller r in place of the mass m?

A. No.

XQ. 632. On page 2, line 20 of this patent of yours in suit, where it is speaking of the roller, it is said, "As the roller is rigidly connected with the rotating mass m, or can be constructed so as to be itself the rotating mass, the film moves uniformly," and so forth. Do you disagree with that statement?

A. No, I do not disagree, because you might build the roller so that it has different parts on the shaft, different diameters. I mean one part of the roller has a diameter comparable with the standard sprocket wheel, and a little farther behind that it might have a diameter three times as big as that. Then you would have built a roller and called the whole appliance a roller, that is, in other words, practically a combination of one part playing the part of a flywheel and a part playing the role of a roller.

XQ. 633. Now, in Figure 2 that is what you have, is it not? You have a roller r which is connected apparently directly on the same shaft with the flywheel m, isn't that true?

A. It is drawn diagrammatically, you cannot see very much about how the actual construction is made.

XQ. 634. And the roller r is itself the rotating mass, is it?

A. Pardon me. The roller r?

XQ. 635. Is itself the rotating mass?

A. No, certainly not. In Figure 2 there is a mass m.

XQ. 636. Now, you say in your patent that the roller r may be itself the rotating mass. Do you deny that now?

A. Yes, I should interpret it just in the way I just tried to explain.

XQ. 637. Is anything said in the patent in suit as to the size or moment of inertia of the flywheel, any instructions given there as to what size flywheel to use or what its moment of inertia can be?

A. Excuse me for just a moment, looking over it. Yes. It gives some points, in so far as it says the flywheel—It says, on page 2, line 32, and the following: "engagement with the flywheel, . . . its resulting tension, with the result that any such irregularities are effectively prevented from being imparted to

the film at the point of translation." That means you have to have a flywheel of a certain amount of momentum, but you have not to go to any size; it is not necessary to go over a certain size of a flywheel. You do not need a flywheel of, say, three feet diameter.

XQ. 638. Would a seven pound flywheel of a certain shape and design have the same effect, for the purpose of this patent, as a five-pound flywheel of the same shape and design?

A. Before I answer this question I must ask you what you mean by a five and seven pounds. Do you mean the weight of the flywheel?

XQ. 639. Yes.

A. You know, the weight of a flywheel does not give you moment of inertia.

XQ. 640. I know. That is why I put in the words "of the same shape and design." Would a seven-pound flywheel of a certain shape and design have the same effect for the purposes of your patent as a five-pound flywheel of the same shape and design?

A. That is very difficult to answer without actually trying it out.

XQ. 641. The patent does not answer that question, does it?

A. Yes, it does. It tells you to try it out, which flywheel you need. It is not possible—if I may add—to give exact figures in a patent application, or it is not useful and suitable to give exact figures as to the weight and dimensions.

XQ. 642. You referred yesterday to a letter from the Tri-Ergon A. G. to somebody—to whom is that letter addressed (showing)?

A. To the Tri-Ergon Betriebs Gesellschaft.

XQ. 643. What does that mean?

A. That means—Betriebs means "working company," or rather, it was the workshop in Berlin, the laboratories in Berlin.

XQ. 644. It was addressed to you and your associates there, is that it?

A. Yes.

XQ. 645. Now, that letter is dated May 2d, 1925?

A. Yes, it is.

XQ. 646. It is in German. I don't read German but I have had somebody go over it and tell me what is in it; and I gather from it that the Tri-Ergon Company, writing the letter, is complaining because you were not delivering in 1925 the machines that they want—you are delaying shipments and constantly changing designs. Is that it?

A. No. I don't think that there is a constant delay of changing designs.

XQ. 647. Perhaps not constant.

A. (Continuing.) Because it says here we had the designs for recording and reproducing finished at the time of June '24 and they are complaining why they don't get the machine, there was delay in building them.

XQ. 648. Well, Mr. Massolle had written them that they were designed?

A. Yes, and they were designed at that time.

XQ. 649. And then look at the end of the paragraph that is marked A, end of the section that is marked A.

A. This one here?

XQ. 650. Yes.

A. Yes.

XQ. 651. Don't you find it is there said that today they are disappointed again, they found that you were about to begin the manufacture of a machine of a construction "of which we are skeptical as regards its practicability"?

A. Yes, but that was a very silly idea of a man who did not understand anything about it.

XQ. 652. Who was this gentleman that did not understand anything about it?

A. Yes, but——

XQ. 653. Who was it?

A. The man who signed the letter?

XQ. 654. Yes, but who was it?

A. The managing director at that time.

XQ. 655. The managing director?

A. Yes.

XQ. 656. Don't you find it is stated that the writer says that he hopes soon to hear that the expensive experiments in regard to the improvement of the recording apparatus have been brought to a head?

A. I didn't quite catch your question.

(Mr. Neave repeated the question to the witness.)

A. Have been brought to——?

XQ. 657. To a head, have been finished, have been terminated?

A. No. The writer states that the expensive experiments have given the results which will show up before the—what is that—before the—which can be shown to the public, or which will stand up.

XQ. 658. That is, he is hoping that that has been the result?

A. Yes.

XQ. 659. Now, the letter goes on to request immediate curtailment of expense and refusal to grant your request for an increase in salaries of the personnel and altogether seems rather disgruntled, if you understand my word?

A. Yes.

XQ. 660. Were those machines they were complaining about ever delivered?

A. Yes, they were.

XQ. 661. What became of them?

A. Pardon me?

XQ. 662. What became of them?

A. They were, as far as I remember, partially sold. Two of the machines—or rather, one machine and the parts of another machine were brought over here to your country.

XQ. 663. In your testimony yesterday when you had that list of installations, you remember, the last was in June of 1924?

A. Yes.

XQ. 664. Were there any installations made after that time, any showings in the theatres with your apparatus after that time?

A. I think so.

XQ. 665. You are not sure?

A. I am not sure, because I returned I think in June or July to Germany.

XQ. 666. Well, now, in the years 1925, 1926 and 1927 were there any motion picture films being exhibited anywhere in Germany?

A. Yes. I think the producing concern called Ufa made sound—tried to make sound picture films.

XQ. 667. Were there any productions of sound picture films in Germany in those years, 1925, 1926 and 1927?

A. The Ufa people made.

XQ. 668. In the theatres?

A. Reproduction, you mean?

XQ. 669. Yes.

A. Yes.

XQ. 670. In theatres?

A. I remember they showed some of their films in the theatres.

XQ. 671. During those years?

A. I should not say during those years. Sometimes they showed.

XQ. 672. Now, your apparatus was not used in those years, was it, in actual reproduction of pictures in Germany?

A. Why, yes, it was, but not as far as we should wish.

XQ. 673. Was it used at all, didn't your work come to an end, didn't you tell me that your backers had refused to put up any more money?

A. Yes. But I just tried to tell you that the Ufa experimented around with sound pictures about that.

XQ. 674. There were no regular commercial productions of sound pictures in 1925, 1926 and 1927 in Germany?

A. That is true, no regular commercial production.

XQ. 675. Now will you turn your attention, or turn your thought, back to photo cells, that you were testifying about yesterday. You say that there was some doubt as to the proportionality of the changes in current to the changes in the light on the cell. Now, was the doubt as to that proportionality a question of slight departure, or such a serious departure as to make the cell unsatisfactory for sound reproduction?

A. I think I told yesterday that the question of proportionality with changing intensities, that is, with frequencies——

XQ. 676. That is right.

A. —was not checked up at all.

XQ. 677. What was checked up?

A. The proportionality between constant illumination and current produced in the PE cell.

XQ. 678. Then you mean that you only measured, you only subjected the cell to a constant illumination and looked to see whether you got a constant response in the source of current?

A. Oh, pardon me, no, I didn't mean that. I said there was dispute in the physical literature about the

properties of the PE cell. This dispute dealt only with the relationship between constant illumination and current through a PE cell. It did not deal with the properties of a cell, in case you illuminated it periodically; nobody had tested that at all before us.

XQ. 679. I see what you mean now.

XQ. 680. You had had prior work with photometric cells, hadn't you, prior to 1918?

A. Yes.

XQ. 681. And you had used them for photometric purposes, haven't you?

A. For photometric purposes, I was interested at one time using them for analyzing spectrograms, for instance, measuring the densities of spectrograms on photographic plates, and so on.

XQ. 682. Now, they were not useful for the photometric purposes or for those purposes that you have just spoken of unless there was substantial proportionality between the illumination and the current, were they?

A. That is not necessarily the case, because in all those kind of investigations, you print density marks on the plate you are measuring, and use these density marks as units for density; that is, you bring marks on the plate of which you know which illumination belongs to that mark, so that you can check up the photoelectric currents or—now, just a moment—transverse the photoelectric currents measured in the light intensities of the source which made your spectrogram.

XQ. 683. But if the photoelectric cells had not had substantial proportionality between the illumination and the current, they would not have been very useful for those photometric and spectrum purposes, would they?

A. Why not? I just tried to explain that it might have any relationship. It was just a means to detect very feeble intensities.

XQ. 684. A selenium cell would do just as well, then, for the purpose?

A. It might, because you use reference marks of densities.

XQ. 685. Then you in your work tested these photoelectric cells to see whether they responded proportionally to changes in intensity, did you?

A. The work of myslf and my collaborators?

XQ. 686. Yes.

A. Yes.

XQ. 687. And you had never done that until after the summer of 1918?

A. I have never done it before the summer of 1918?

XQ. 688. That is right. Is that what you mean?

A. Yes.

XQ. 689. Now, are the present day photoelectric cells perfectly constant in sensitivity?

A. I think they are to a rather large extent.

XQ. 690. Not entirely constant, but they approach constancy?

A. No. I mean there are certain types of cells on the market which are not constant, and you can find cells which are really very constant.

XQ. 691. Do the photoelectric cells used today in the sound pictures have gas present in the cell for the purpose of increasing the sensitivity?

A. Sometimes the cells are filled with gas in order to increase the sensitivity. But as far as I know, vacuum cells have been used too.

XQ. 692. You did not use any of that gas material back there in 1919, 1920 and 1921, and 1922?

A. Yes, I did.

XQ. 693. You did?

A. That has been shown already by Elster and Geitel to use this effect.

XQ. 694. Way back in 1890?

A. Pardon me?

XQ. 695. Back in 1890 or 1894?

A. 1894, yes.

XQ. 696. Do the present cells have perfect proportionality between the illumination and the current?

A. Yes.

XQ. 697. Perfect?

A. In a way, perfect enough to——

XQ. 698. Perfect enough, yes.

A. —to give good quality in the reproduction.

XQ. 699. Was there any question among physicists in 1918, so far as you know, as to the practically instantaneous response of the photo cell to changes in illumination?

A. That had not been tested, as far as I know.

XQ. 700. Was there any doubt as to the constancy?

A. I could not say there was doubt, because it was not a matter of question.

XQ. 701. Is the glow tube used in Germany today in sound work?

A. Yes, it is.

XQ. 702. Is the Kerr cell used?

A. Yes, it is too.

XQ. 703. Which is used the most?

A. I think about fifty-fifty. The Siemens and the Klangfilm people are using Kerr cell. The Tobis people are using glow discharge.

XQ. 704. What was this Kerr cell? Was this a light valve?

A. If you use the expression "valve" in a general way, yes; but the valve is without any mass.

XQ. 705. Do you know whether or not the Tri-Ergon A. G. sent Mr. Schroeder here in 1925?

A. No, I don't know about that.

XQ. 706. You were here in 1925, weren't you?

A. No, I was here in 1924 the first time.

XQ. 707. You were not here in 1925?

A. No.

XQ. 708. You remember this Exhibit No.3 we have been talking about, your flywheel patent in Germany. Do you know whether you filed corresponding applications for patents in other countries on that same thing?

A. No. I can tell you nothing about it. I only know about having seen it in the court that we filed one in the States. I don't know even that.

XQ. 709. Now, as to your laboratory notes that were produced yesterday.

MR. NEAVE: Your Honor, we looked those over last evening. Mr. Ward kindly let us have them, and we looked at all but the two sheets which he asked us not to, and of course we did not.

MR. WARD: May I say, Mr. Neave, that those two sheets simply show special forms of glow lights and nothing else. I wanted them to look at them if they wished, but I did not care to have it brought out here, as it has no bearing on the issue here at all.

XQ. 710. Those laboratory notes, Doctor, they were of course not all of the laboratory notes that you had?

A. No.

XQ. 711. And these are a selected lot of laboratory notes that you brought with you?

A. No, they are not selected. We had at that time quite a number of file wrappers used at the same time for different purposes, and I happened to find this one and other ones too, relating to other matters, I think a year or two years ago.

XQ. 712. All of those notes seem to be in handwriting.

A. Yes.

XQ. 713. I believe I am right?

A. Yes.

XQ. 714. Whose handwriting?

A. Different people's handwriting.

XQ. 715. Any of your handwriting in these notes?

A. If you will be as kind as to give it to me I will look.

XQ. 716. As you look over each page, find out whose handwriting is on each page.

A. I can't tell you anything exact about the handwriting, because I don't know. Apparently it has been the handwriting of Vogt, some pages are signed by Massolle, there apparently is handwriting of several pages by one of our assistants.

XQ. 717. Do you find any of your own handwriting there?

A. These figures seem to be written by me.

XQ. 718. A sheet of figures?

A. And here seem to be written by me, but I am not sure.

XQ. 719. Are your initials or name on any page?

A. Yes. Something is signed here by me.

XQ. 720. You have got an E on a sheet of plotting paper there, is that it?

A. Yes. But it is this, that this signing does not mean very much——

XQ. 721. Mr. Vogt's initials are at the bottom of many pages, aren't they?

A. Yes, he used them quite a lot as writing down data.

XQ. 722. They are not really his initials; they are some queer initials?

A. Pardon me?

XQ. 723. What are those initials at the bottom of the page you are looking at? "gt", aren't they?

A. Yes.

XQ. 724. That is the way he initialed the pages, with those two letters; isn't that it?

A. I don't think that those are his initials. I am not exact on that.

XQ. 725. I understand from Mr. Ashton that last evening you told him that is the way he signed.

A. He signed another way. He signed with a "V".

XQ. 726. Did he take "gt", the last two letters of his name?

A. No. He certainly did not sign with the last two letters of his name.

XQ. 727. Whose initials are "gt"?

A. I don't know.

XQ. 728. You were not responsible for keeping these notes, were you?

A. Nobody was responsible.

XQ. 729. While my associate is looking over that book, let me ask you some additional questions and we will come back to that. This series of notes shows experimentation with optical and physical slits and speed variations in 1920 and 1921, does it not?

A. Yes, an arrangement of flywheel on shafts and so forth.

XQ. 731. When had you succeeded in doing what you were attempting to do in that relation?

A. We succeeded at about the time of our last German application.

XQ. 732. What is that date? I don't know when your last one was.

A. I don't know it, either.

XQ. 733. You mean the last that you three put in together?

A. Pardon me?

XQ. 734. The last application that you three filed in your three names; is that what you mean?

A. There is a combined United States application on the subject. It is combined by three German applications. What I meant was the last one of these.

XQ. 735. Do you mean this application for the patent in suit?

A. Exactly. This is a combination of the three German applications.

XQ. 736. You felt that when you filed that application your work of development was complete?

A. About completed, yes.

XQ. 737. So that this patent in suit represents the summation and the height of all of the work that you or your associates were doing along those lines, does it?

A. I could not tell you that, because we gave over to our patent attorney all which we did think advisable to apply for a patent, and we were not of course responsible what our attorney did with the material that we gave him.

XQ. 738. But then that United States Patent upon which this suit is brought, does that represent the summation of all of your work and the height of the development that you came to?

A. Yes, I think it does.

XQ. 739. Now, will you turn back to this binder of notes and look at that page I show you? That is Mr. Vogt's handwriting?

A. It is composed of different handwritings. This is written by another handwriting.

XQ. 740. The notes in pencil?

A. Yes.

XQ. 741. The ink parts are all Mr. Vogt's?

A. Yes, I think they are.

XQ. 742. Look at another sheet. I still hold my finger with the first one. Is that Mr. Vogt's writing?

A. No, I don't think so. It looks different to me.

XQ. 743. Is the next Mr. Vogt's writing?

A. Yes, I think that is Mr. Vogt's writing.

XQ. 744. Those three pages that I have referred to relate to constancy of speed, don't they?

A. Yes, they do.

XQ. 745. Are there any other pages in the book that relate to constancy of speed?

A. Yes, this one, for instance.

XQ. 746. Who wrote that?

A. That is apparently signed with this other signature again.

XQ. 747. That is Mr. Vogt?

A. I am not sure about it, but it might have been, yes. You see, I cannot remember all of those details.

XQ. 748. You found in your work, didn't you, that the exact guidance of the film at the focus of the objective was possible only if you caused the film to run over a toothed roller during the exposure?

**A. No.**

By Mr. Neave:

XQ. 749. I am quoting those words from an article of Mr. Vogt's. You don't agree with it?

A. No.

Mr. Ward: What article of Mr. Vogt's?

(Mr. Neave hands papers to Mr. Ward.)

By Mr. Neave:

XQ. 750. In your machines that you delivered and used, did not the film run over a toothed roller during the exposure, both in recording and reproducing?

**A. Yes.**

XQ. 751. And that is what you found to be best, isn't it?

A. No. I tried to explain——

XQ. 752. Why did you use it then?

A. It was good, but there are other arrangements that are as good as this.

XQ. 753. The tests that you made showed variations due to the sprocket teeth, didn't they?

A. One of the tests showed, yes.

XQ. 754. How did you make those tests?

A. The glow light discharge was modulated with a constant frequency and the film run through the machine, the film developed, and here you see the result.

XQ. 755. That is the film you are pointing to. You get the information from that result just by looking at the film, or did you put it through a sound projector?

A. No, by different means. One way of checking was by running it again through the machine and hearing, and another way was by measuring the distance between the variations of density.

XQ. 756. The notebook that you have here showed that you or your associates were constantly in touch with Zeiss. Who was Zeiss?

A. Zeiss is a large optical concern.

XQ. 757. And you were getting information from him and he was making things for you; is that it?

A. Yes. He was the most dependable concern we could get lenses from.

XQ. 758. You were also working with Zeiss and taking up with him the question of the slits, weren't you, as shown by those notes?

A. Yes, so far as Zeiss gave us specially made condensing lenses to illuminate the slit as intensely as possible.

XQ. 759. You testified yesterday, I believe, that there was no lag in the photoelectric cell and amplifier; is that true?

A. Yes.

XQ. 760. What degree of equal response or sensitivity did you find over the desired range of frequencies in using the glow tube and the recording amplifier?

A. We found an equal response at that time in a frequency range, say from sixty cycles or seventy cy-

cles up to about eight or nine thousand. That was the highest which we were able to record at that time.

XQ. 761. And did you find equal sensitivity for each of the frequencies?

A. That means that the sensitivity fell off at about fifty cycles, and probably at about eight thousand cycles.

XQ. 762. How did you make the tests of that?

A. First, we recorded and looked whether we got sharply defined intensities or intensity variations; then we ran through this record again and tested it in this way by the reproducing machine. Then we made the following arrangement: We connected reproducing means, that is loud speakers and so forth, directly by our amplifier to our transmitter and our microphone and saw whether we get through all of those frequencies; and the last means was the following: We tried to modulate or tried to influence the PE cell directly with the glow discharge.

XQ. 763. Was the response the same at 10,000 cycles as at 1000 cycles?

A. I said that up to 8000 cycles we were able to have about equal response. At 10,000 cycles probably the response was less.

XQ. 764. Have you got any quantitative data on any of that?

A. No, I have nothing with me, and I don't remember just now any figures on that.

XQ. 765. Do you know whether you got a sine wave output for a sine wave input?

A. I beg your pardon. I did not quite understand you.

XQ. 766. Do you know whether you got a sine wave output for a sine wave input?

A. Yes, we investigated this matter very thoroughly as we made photometric measurements of the

density variations after having printed a negative record on positive raw stock, and saw whether the density variations corresponded to a primary sine wave.

XQ. 767. Did you use an oscillograph in making any of those tests?

A. No, we did not use at that time an oscillograph.

XQ. 768. When did you first use an oscillograph?

A. I used an oscillograph, I think, first——

XQ. 769. Perhaps my question was not clear. I mean when did you first use the oscillograph on these tests on sound?

A. I gave the answer that we did not use at that time an oscillograph.

XQ. 770. When did you first use an oscillograph on these tests on sound?

A. It was about in the year 1925.

XQ. 771. These notebooks refer to a one-half H. P. motor. Is that a powerful motor, would you say, for this work?

A. These notebooks refer to that? I don't know anything about it.

XQ. 772. Somewhere near the back. Was a one-half horsepower motor a powerful motor for those uses?

A. I would not call it a powerful motor, but a motor which might do the necessary work.

XQ. 775. Is it true that the gist of the patent in suit here consists in arranging a flywheel at the translation point, as we have been calling it, so that the movement of the film will be uniform at all times at that point?

MR. WARD: Are you asking him about the patent, the claims of the patent?

MR. NEAVE: I don't care what the claims are. I am speaking of the work that he did. I meant the gist of the work.

Mr. Ward: You don't mean anything about the scope of the patent?

Mr. Neave: I am not asking him to construe the patent at all, but the gist of the work that is covered in the patent in suit. What was the whole point of that?

A. That the flywheel has to be applied at or in the vicinity of the translating point.

XQ. 777. So you do not think the gist of it all was to have the flywheel at the point of translation?

A. No. I showed you some notes in these laboratory files which will show you that you get good results with the flywheel adjacent to the translating point.

XQ. 778. The advantages of your invention would still exist even if the flywheel were connected through gearing to the shaft that is to be driven constantly?

A. Unless the gears introduce new irregularities——

XQ. 779. Would the gears necessarily introduce new irregularities? The mere fact of having gears there?

A. I certainly would consider it a possibility and would check up whether they do or do not.

XQ. 780. I gave you the wrong patent a moment ago about the powerful motor. This Massolle-Engl-Vogt Patent No. 390,190, a German patent; doesn't that speak about the powerful motor, and what do you mean by that?

A. No. It says the following: that it is proposed here in this patent description to use a motor of bigger size than ordinarily necessary.

XQ. 781. Why use a motor of bigger size?

A. The reasons are the same I gave, I think, either this morning or yesterday, in order to be able to give the motor an additional load.

XQ. 782. Would a one-half horsepower motor do that?

A. I would rather should like to use then, if I wish to give the motor an additional load, maybe a one horsepower motor.

XQ. 783. So that you use there a larger motor to take an additional load, and you put a load on to it by means of a brake, don't you?

A. Either a brake, or in the patent is given the method of using an eddy current brake or generator used as a load.

XQ. 784. And when you use that arrangement you can dispense with the flywheel?

A. Yesterday I explained that this was one of the first experiments we made in order to attain constant speed, and we did not get the desired result, so I might draw the conclusion that this additional load is not equivalent to the flywheel.

XQ. 785. Before you began testifying in this case you of course had talked over with the plaintiffs' counsel here this question of joint inventorship, hadn't you?

A. No, we did not speak about this.

XQ. 786. You did not mention it at all?

A. No.

Mr. Ward: Before we get too far, may I have it appear on the record, your Honor, that this German Patent No. 390,180, that Mr. Neave has referred the witness to, is one the application for which was filed May 25th, 1921.

XQ. 787. Dr. Engl, you have testified in this country in English language on several occasions prior to this, haven't you?

A. I have testified on two occasions, I think.

XQ. 788. In English?

A. In English.

XQ. 789. But you speak very well. Have you studied it for years?

A. I have learned English in Germany and was quite an amount of time in Great Britain and in the United States.

RE-DIRECT EXAMINATION.

By MR. WARD:

RDQ. 790. Doctor, referring to your first German application, Exhibit 3, you stated that you did not try the structure shown in that German application before you filed the application or afterwards. Will you please state why you did not try it?

A. Before we applied for a patent, we just had a rough idea in our minds what we intended to do, and after we had applied for the patent and were going to construct anything like the things described in the specification, we found out very quickly that an arrangement of that nature would be inoperative, so we did not take any trouble to try it out at all.

RDQ. 791. Did you say it would be operative or inoperative?

A. We found that it would be inoperative.

RDQ. 792. With respect to the filing of this first German application, did you and your colleagues get the idea of either a glass roller or a divided sprocket for permitting the use of the translation point at the film roller?

A. No, we put in this sentence in the description just to have a more general scope of the patent, and we did not think at the time of applying for a patent how we might actually construct a structure after the patent specification.

MR. WARD: I think it should appear on the record, your Honor, because I have been under a misapprehension, and I think the Court has too, that Mr. Neave's questions relating to that sentence which suggested that these two rollers, these

pinch rollers shown in the German application and patent, the first German application, that that sentence which Mr. Neave read to the witness, stating that that roller might be placed at the translation point, does not appear in Exhibit 3, to wit, in the German application, and it was not in there when that application was filed. It does appear in the German patent and, apparently through the Patent Office or somebody else later on, that sentence was stuck in there.

MR. NEAVE: The witness has just said that he put it in there for a purpose.

MR. WARD: Who said that?

MR. NEAVE: The witness said he put it in there for a purpose.

MR. WARD: I just want to bring up the point that it was not in there and does not form a part of that original disclosure and shows on its face that the thing was something that must have been thought of afterwards.

RDQ. 793. Doctor, with regard to this sketch that Mr. Neave had you make on this subject, Defendants' Exhibit 1 (A) for identification, if the flywheel roller shown in either of the figures of the first German application, Exhibit 3, are put at the translation point, what would be the result for recording or reproducing? That is, I will put in the translation point in the sentence which Mr. Neave read you from the German patent.

A. The result would be for both recording and reproducing that the arrangement became still more inoperative than it is without this change, because the light rays from the recording lamp could not impinge on the light-sensitive film, the roller $r_1$ being in the way; and for reproducing, not only the roller $r_1$, but

roller $r_2$ as well, is in the way between the light source and PE cell, so you would not get any light on the film or any light through the film.

RDQ. 794. At the time of filing that first German application, did you have any means worked out which would enable you to move that roller and flywheel down at the translation point, and have it operate there?

A. At the time of applying for that?

RDQ. 795. Filing this first German application, Exhibit No. 3?

A. No. We had not.

RDQ. 796. You were cross-examined about a flywheel on a motion picture machine, Defendants' Exhibit C for identification, and you had something to say in response to Mr. Neave's question about the use of that flywheel being to insure the proper operation of the intermittent sprocket. Will you please take this exhibit up to the Court's chair—if I may put it before your Honor—and explain to the Court more in detail just what you meant by the fact that the function of that flywheel was to drive or control that intermittent sprocket, and also include in your answer, also continue your answer, by pointing out to the Court the difference in the action of that flywheel in that apparatus, and in a sound head.

A. This shaft, your Honor, is the driving shaft, having the flywheel on its one end. And you see that when I turned this shaft around, this sprocket wheel is now at rest. I can turn the flywheel around quite a bit till at one position the sprocket will begin to move; and then it stands still again, for quite a time; and then moves again. So this sprocket wheel is moved in jerks, intermittently. And at every moment where the motion of the sprocket wheel is brought about, the flywheel and the driving shaft is under a load. You feel it, if you try to turn it this way, your Honor, and you feel when the sprocket wheel is brought in motion.

So you certainly could not call that a flywheel arrangement which filters out irregularities from a sprocket wheel. Furthermore, it is quite another proposition in so far as there is a certain looseness in the gears—one can tell it by touching it here.

MR. WARD: Let the Court put his finger on the sprocket and then turn the flywheel and feel that.

RDQ. 797. Now, Doctor, will you start backwards. You pointed out that there is a certain amount of play or looseness between the flywheel shaft and the sprocket even after you brought the flywheel up where it had the load of the sprocket. Will you state what that amount of play or backlash would do on a sound film?

A. That would create quite perceptible changes in speed. A constant pitched tone would always vibrate above and below the pitch it should give; it would give a sort of a whining effect on the hearer.

RDQ. 798. And with regard to the fact that you pointed out that this flywheel in its normal operation on this motion picture machine had a substantial rotation before it picked up the intermittent film sprocket, will you please measure that roughly and state how much of a revolution or how many revolutions there are before it picks it up? Just roughly.

A. It is about one full revolution of the flywheel.

RDQ. 799. And the flywheel in this exhibit which you are talking about makes approximately one revolution without the load of the intermittent sprocket?

A. Not quite one revolution and the rest of the one revolution under the load of the sprocket.

RDQ. 800. In the greater part of one revolution it is free of load and then during the remainder of that revolution it takes on the load?

A. Yes.

RDQ. 801. What would be the effect of an abrupt changing load applied to the flywheel shaft of your sound head?

A. The speed of the film coupled to the flywheel would change.

RDQ. 802. And if this motion picture exhibit here did not have the flywheel on it, what might happen when the picture comes to rest?

A. The thing might not move at all and the whole machine might be broken if you put force to it. The flywheel has here the function of overcoming this dead center position of this sprocket wheel and the intermittent movement inside.

RDQ. 803. About how many times a minute does a motion picture stop at the gate with this intermittent sprocket?

A. About twenty-four times sixty. That is, 144 times a minute.

RDQ. 804. Well, it is about twenty-four to the second?

A. Twenty-four to the second, or 144 to the minute. Oh, pardon me. No; it is, of course, 1440 per minute.

RDQ. 805. Now you pointed out some differences, in answer to Mr. Neave's questions, I believe, to the useful function of a flywheel in your use of it in the sound head, where it was applied at the film, and the use of the flywheel for general purposes. Are there any other differences that you did not mention to him?

A. Usually flywheels are used in machinery work to overcome changes of load, as this example has shown with the model. And the use of a structure called flywheel to obtain constant speed seems to me a different proposition from the one I just mentioned overcoming variable loads.

RDQ. 806. Now, you were cross-examined about governors, speed regulator governors, and you were

asked if a governor was not a flywheel. In the operation of a governor is the inertia of the rotating mass of the balls a constant one, or does it vary as the balls move outwardly to a greater diameter as the speed increases?

A. The inertia varies with the increasing speed, on account of the radius increasing and the speed increasing.

RDQ. 807. If the speed increase so that the balls move out, you have what? A greater inertia or a less inertia?

A. A greater inertia.

RDQ. 808. And if the speed checks or tends to check and the balls move down, you have a——

A. A smaller inertia.

RDQ. 809. In the use of a flywheel is it customary to have a device with the changing inertia of that kind?

A. No. A flywheel is a device the inertia of which is constant.

RDQ. 810. If a governor is useful or put on a shaft to operate or function—and by governor I am speaking now of the ball governor, the usual governors, or equivalent ones—will they function unless there is some change in the speed of that shaft?

A. No, they will not. They just begin to function when there is a change in speed. Otherwise the governor would rotate with the same revolutions per minute and nothing would happen.

RDQ. 811. The use of the governor requires a change in the speed of the shaft on which it is put to function?

A. Yes.

RDQ. 812. Is there any such idea or relation in the use of a flywheel?

A. Pardon me?

RDQ. 813. Is there any such relation or function in the use of a flywheel?

A. No. I think the idea underlying the use of a flywheel is a fundamentally different one. In a flywheel you have an arrangement with a constant inertia, which is always controlling the member which it has to control, that is, the film—of very little mass; whereas a governor has a variable inertia, it is controlling a piece of machinery which it controls only when the speed of the machine is changing.

RDQ. 814. You were questioned by Mr. Neave about the effect of putting some spur gearing between the sprocket $r_2$ and Figure 1 of your patent, and the roller $r_1$. As I recall it, he assumed that you would have two or three spur gears gearing up those two rollers, and he asked you—as I remember—whether the flywheel shown in that figure would in such a modification of the figure smooth out the irregularities in speed so as to give uniform movement of the film. And it was not quite clear to me whether your answer was that in such a construction all of the irregularities would be smoothed out, or only some of them. Will you please state that again?

A. If I introduce a gearing device between those two shafts, I of course introduce a new source of irregularity, which reacts on the speed of the film. Now, in the case of the flywheel being coupled rigidly to the shafts, I might still have some of the irregularities of the gears influencing the speed of the film; I would have that in case of the structure shown in Figure 1, and in the case of the change just proposed. In order to get rid of those irregularities still left I would use the resilient coupling of those flywheels to the shaft. Then of course I would not introduce any new irregularities, because those very small irregularities would be filtered out then by the resilient coupling, by the co-operation of the flywheel mass and this very feeble spring.

RDQ. 815. Then with the proposed modification of Fig. 1 you get some irregularities out, but not all. Some irregularities would still remain?

A. Yes.

RDQ. 816. Now, you were questioned in regard to a spring to be used in driving the flywheel, and Mr. Neave asked you about what your patent taught in that connection and asked you some questions about the spring being located in normal operation between the stops. I did not get quite clearly—and I don't think the Court did—your testimony on that point. What did you mean by that?

A. There is a certain amount of friction in the bearings of the shafts and so on; and in order to have the film plus flywheel running at constant speed we have to take care of this amount of energy which is lost in the frictional processes, it must be delivered to the film plus flywheel. This is done by a very feeble spring coupling between flywheel and arm; the arm being driven by the motor and the gears between arm and motor. The spring should be just strong enough to be capable of transmitting that small amount of energy. If you take a stronger spring, the system of this mass, together with the rigidity of the spring, is equivalent to a system capable of oscillating. That explains what Mr. Neave asked about any oscillations being created by a spring. These oscillations, of course, will die out sooner or later as there is a dampening through the frictional losses in the bearings. When there are no irregularities, these oscillations of the systems are not brought forth at all; they will not appear. But as soon as you, for instance, touch the flywheel, give it a change in speed, you will be able to detect these oscillations, which will die out very quickly, quicker when the spring is very feeble and quicker when there are frictional losses in the system —which always exist. That is the reason why, in the

patent description, we spoke of a very feeble spring. A stronger spring would emphasize the possibility of those oscillations.

RDQ. 817. You gave some testimony in answer to Mr. Neave's questions with regard to the date when the optical slit was perfected by you and your associates, and it was not quite clear to me whether you said that that had been perfected at the time or just before the filing of the United States patent, or before the time of the filing of one or more of the German applications on which that patent is predicated. What did you intend to testify on that point?

A. About the optical slit?

RDQ. 818. Yes. I understood your testimony, but——

A. It can be seen from our notes that we were clear with the optical slit and had it fully constructed somewhere in the year 1921. In order to give the exact month I should recall it back to my memory by looking at the page. For instance, we ordered parts for the optical slit arrangement October 1920. There is one sketch, giving an optical slit arrangement here, dated October 20th, 1920. The sketch with full details, I think, was here, which accompanied a letter to the Zeiss people dated March, 1921.

XQ. 819. Did you mean by your testimony that you gave Mr. Neave a while ago—I may have heard it wrong, but my recollection is that you testified—that the optical slit had been perfected at about the time you filed the United States application in suit. And that was filed March 20th, 1922.

A. No. It appears from our notes that we were clear about the optical slit arrangement a bit earlier than that.

MR. WARD: I might point out, your Honor, that the figures on which this U. S. patent were filed, were filed in Germany in the year 1921.

RDQ. 820. You were asked if the United States patent in suit represented the culmination of all of your work, the work of you and your associates; and I think your answer was in substance that that was so. In that connection, were you referring only to those features which come into this patent, or were you referring to all of your work? That is, did you do any further work in this general line after the date of March 20th, 1922?

A. Yes, I did further work.

RDQ. 821. And you and your colleagues did further work in this art after that date?

A. No. I was now thinking of my own work, in the years later on, you see.

RDQ. 822. Will you state again—if I didn't get it—when you and your colleagues did cease working together on this art?

A. I think in the year 1925 or '26.

RDQ. 823. That is, you were working together with Vogt and Massolle at that time?

A. Yes.

RDQ. 824. Were any applications filed by you after March 20th, 1922, by the three of you?

A. No, not that I know of.

MR. NEAVE: Did you say March, 1922?

MR. WARD: March 20th, 1922.

MR. NEAVE: No applications filed by the three of them since then?

MR. WARD: That is what he says.

THE WITNESS: Applications filed on the subject.

MR. WARD: What?

THE WITNESS: I mean applications filed on this specific subject here.

RDQ. 825. You mean on the subject of this patent?

A. On the subject of film constancy.

RDQ. 826. Well, what I am trying to bring out, Doctor, as I would like you to clearly understand the question, is whether in your answer to Mr. Neave's question or my question you meant that after March 20th, 1922, you and your colleagues had reached the culmination of all of your work in this art. Because that is the way he put the question to you.

A. I think I answered with yes. Yes.

RDQ. 827. Now you say that you only meant that you had reached the culmination with respect to the subject matter of this particular patent in suit?

A. No. The culmination of our work dealing with the constancy of film in the sound picture work. I mean, we probably were able to improve other parts of sound picture recording and reproducing.

RDQ. 828. And did you go on working after March, 1922, on these other problems?

A. Yes, we did.

RDQ. 829. Reference was made to some correspondence with the Zeiss firm, in the laboratory notebooks. What was his business, or his firm's business?

A. It is a large optical concern, manufacturing microscopes, all kind of optical systems, spectrographs, astronomical tubes, dealing with all kind of optical arrangements.

RDQ. 830. Were you buying lenses from them——

A. Yes.

RDQ. 831. —or were you getting them to work out these problems for you?

A. No. We were buying lenses from them, and we were asking them about the properties of those lenses under certain conditions, whether they were the right lenses for giving sharp images at certain focal distances, and so on; any kind of knowledge that

they might have and which we did not have in respect to optics.

By Mr. Neave:

Q. From whom did you purchase your motion picture projectors that you used at the beginning of your work as you went along with it?

The Witness: I remember we purchased the first motion picture projector after having built this what I called framework 1 and 2, from a firm with the name of Ertel. I think this firm does not exist any more. And we used those to build about three or four of these heavy iron structures. After that we purchased our picture heads from the Krupp Ernemann people.

By Mr. Ward:

RDQ. 832. Doctor, when did you land in New York on this trip?

A. I arrived just before—one week Wednesday, last Wednesday.

RDQ. 833. Last Wednesday. About how many hours altogether have you been with me or my associate, Mr. Haselton, in regard to this trial, roughly speaking?

A. Up to this moment now?

RDQ. 834. Yes, up to the time you came here for this. When did you arrive in Scranton, first?

A. I arrived in Scranton Sunday afternoon.

RDQ. 835. Sunday afternoon?

A. Up to that I think about three hours, and in Scranton I might have been together with you—of course, in the courtroom here, and out of the courtroom, perhaps, oh, one hour or one and a half hours every day.

RDQ. 836. Every day?

A. That is for two days.

RE-DIRECT EXAMINATION (Continued).

By MR. WARD:

RDQ. 837. Dr. Engl, Mr. Neave referred you yesterday afternoon to an article in German entitled "The Talking Film According to the Tri-Ergon Process," and read to you some excerpts therefrom. This is an article by Hans Vogt, one of the applicants of the patent in suit; and handing you a photostat copy of that article which Mr. Neave supplied me with, I will ask you if you will please read another excerpt from that article which Mr. Neave did not refer you to, on page 1 of the article.

A. (Reading.) "The necessary labors were carried out by Joseph Massolle, Dr. J. Engl and the author,"—the author is Hans Vogt,—"in Berlin during the period from 1918 to 1924, in equal participation. This inventor group, which was formed at the suggestion of the author for joint work on this problem, applied to itself the distinctive word 'Tri-Ergon.' This word was also used to designate the results of the joint activity as well as the enterprise conducting the economic exploitation of these inventions."

RDQ. 839. Will you please state what the date of that article is appearing on the publication.

A. That article has been published February 6th, 1926.

RDQ. 840. And what was the date of the "Film Kurier" article of Vogt's that Mr. Neave first referred you to in which Vogt claimed that the invention was his?

A. The date of this "Film Kurier" article is February 6th, 1932.

RDQ. 841. Mr. Neave questioned you yesterday about a letter from Mr. Constam of the Tri-Ergon, A. G., to a Tri-Ergon company in Berlin, which you said was the Tri-Ergon Working Company, or Works

Company, and Mr. Neave stated in his question in substance that the writer of the letter had stated that you were manufacturing a machine, the construction of which they were skeptical about as regards its practicability, and you stated in answer to that question that that was a very silly idea of a man who did not understand anything about it. Will you please state, if you know, what the feature was that Mr. Constam says he was skeptical about, and whether or not the idea in question was a practical or an impractical one.

A. When the designs were made for the machine which has been mentioned as a lot of 25, the arrangement of the light beams had been changed in so far as in order to get a rigid construction which has dimensions not greater than necessary, the light beams were crossing one another.

RDQ. 842. What were those light beams?

A. The light beams I am speaking of were first the bundle of light rays which were used for projecting the picture images on the screen, and the beam of light which was used for reproducing the sound. These two beams crossed one another at right angles. They did not in the construction before the construction of the lot of 25, and Mr. Constam got the idea somehow in his mind that the intersection of those two light beams might create an interference of the light beams,—that is to say, any variation in the intensity of the light of the arc used for projecting the picture, might affect the light used for sound reproducing. Of course, that is not possible. Any physicist knows that an influence of the two light rays intersecting one another would be a totally new thing, contradicting all experience of the physicists we have up to now. So that is the reason why I said yesterday it was a silly idea of a man who did not know anything about it. As a matter of fact, this lot of 25 machines has been used and, of course, nothing like an interference of these two light beams could be

detected. So it just actually was the following, that Mr. Constam was so irritated on account of the finishing of the lot of 25 taking more time than had been expected, and so he tried to find anything which influenced his mind to give a basis to his complaint.

RDQ. 843. He was the manager of the Tri-Ergon, A. G., the company referred to as a patent holding company holding these patents?

A. Yes. I might add here that he, as a business man, of course did not appreciate the enormous cost of developing work and was astonished that an amount as mentioned in that letter was consumed before the completion of this lot of 25, and for the recording machines too.

RDQ. 844. Was this lot of 25 the first substantial number of machines that had been undertaken to be put into production, or was this a second large lot?

A. It was a second lot, if you allow me to call a number of four a lot too; I don't know whether you will do that.

RDQ. 845. Now, Mr. Neave referred also in his questions—in substance—to the point that Mr. Constam complained about the expenses of the laboratory and wanting to get through with the work. Will you please state what the situation was there with respect to what Mr. Constam expected that work to cost and what he said it cost?

A. As I remember his letter, he expected the expenses for his lot of 25 would be about one hundred and—I don't know exactly whether 90,000 marks or 120,000 marks. As a matter of fact, the expenses for the completing of these machines and laboratory expenses reached an amount of 290,000 marks, so that actually the amount was somewhat higher than originally——

RDQ. 846. Were those German paper marks or gold marks?

A. Gold marks.

RDQ. 847. Mr. Neave questioned you yesterday about where you three inventors had your own laboratory. And then he asked you if Mr. Seibt was there with you and you replied that he was not. And then he asked you how long you three inventors had that laboratory of your own, and you told him three or four years. After reading over this testimony, you stated to me that it might give the impression that you had never had a laboratory with Seibt, and that you wanted to amplify those answers. Will you please state what you want to say about it?

A. I can give a short—a very short historical abstract. It was in the following way: Mr. Vogt worked at Seibt's laboratory during the year 1918, and as far as I know during the years before that. When I met him he persuaded me to come to Seibt's place and work with him together. That happened in the fall of 1918. At about the same time Massolle joined us at the laboratory of Seibt. We all three left this laboratory in January, 1919, so that I personally only was working at Seibt's laboratory for about two or two and a half months. After having left this place, we succeeded in establishing our own laboratories, about in the middle of 1919.

RDQ. 848. And was Seibt ever with you in your laboratory that you told Mr. Neave about?

A. No, he never was.

RDQ. 849. Your connection with Seibt there for two and one-half months was before the time that Mr. Neave asked you about your own laboratory?

A. Yes.

RDQ. 850. Mr. Neave questioned you, commencing at XQ. 661, about what became of a lot of 25 machines that you had built in Germany, and you testified in substance that you did not know what became of all

of them, but you believed that some of them were used in theatres in Germany. And you further testified that the Ufa people were producing sound pictures in theatres in Germany during some of the year of 1925 to 1927—which Mr. Neave asked you about. You further testified that some of these machines of yours were used in actual production of pictures in Germany in those years, or some of those years. But it does not seem to be clear from your testimony what connection, if any, there was between the use of your machines and the use that you referred to of the Ufa people in sound pictures in Germany during these years. Will you please state what the facts were?

A. As far as I remember, the Ufa people acquired a certain number of these reproducing machines of this lot of 25. They installed these machines in some of their theatres. During the year 1926 they spent quite an amount of time and work on recording sound picture film with our recording machines, and using our system. They succeeded in bringing out several films and showed those films to the public. I might add here that the Ufa people had made a license agreement with Tri-Ergon, A. G., Zurich, for the German rights—as far as I remember—and this license agreement expired some years after that on account of the Ufa not fulfilling the contract, they did not work as intensely as the contract prescribed.

RDQ. 851. Do you remember about how long, of your own knowledge, the Ufa people were using your machines in Germany? I mean up to what date?

A. I forgot something to add here. After they had shown these films I was just speaking of, it happened that a new personality, Mr. Kuchenmeister, got in touch with the Ufa people, and this Mr. Kuchenmeister was capable of persuading the Ufa people that he was the only man who understood anything about

sound recording and reproducing. And, as I understand it, it was a matter of policy at that time to—it was a consequence of a matter of policy that Kuchenmeister succeeded in becoming first important personality relating to sound film matters at the Ufa place. As a matter of fact, I remember that several of these machines the Ufa *people* acquired from Tri-Ergon were used by Kuchenmeister later on for experimenting and making shows in theatres, and so on.

RDQ. 852. I again hand you the article by Vogt which Mr. Neave referred you to yesterday, the publication of February 6th, 1926, from which you read an extract just now, and ask you if you will read the last paragraph on page 19 of the translation of that article.

A. (Reading.) "In Germany, the Universum Film Aktien Gesellschaft has acquired a license for the Tri-Ergon process. It is at present engaged in producing the first films by the new process."

RDQ. 853. And that article is dated when?

A. That article is dated February 6th, 1926.

RDQ. 854. That company which this article says was then using the apparatus—is there any other name that that company is called by?

A. Universum Film Aktien Gesellschaft abbreviated is U F A, and is known as Ufa.

RDQ. 855. That is the same Ufa Company that you testified had these machines and was using them?

A. Yes.

RDQ. 856. Can you state from your own knowledge, apart from anything you have read in regard to this article, how late—that is, whether 1925, 1926 or 1927—how late it was that you know that they were using your machines?

A. I know as a certainty that they were using our machines in the year 1927, and I know for a certainty that Kuchenmeister was using our machines in the year

1928. The latter part I know for a certainty, because one of the staff of my own laboratory was at that time with the Ufa people, and he gave me all of the details from what this man Kuchenmeister did with our own machines at that time.

RDQ. 857. Do you know who owns now the German Tri-Ergon patents?

A. These German Tri-Ergon patents are now owned by the so-called Tobis Company.

RDQ. 858. Including the German patents on this arrangement that you have been testifying to here?

A. Yes.

RDQ. 859. What is the Tobis Company? Is it a small company or a large company, and what is it engaged in?

A. It is one of the largest concerns engaged in sound picture work. The other large concern in Germany is the Klangfilm Gesellschaft.

RDQ. 860. Mr. Neave asked you, XQ. 640, in substance that if you had a seven-pound flywheel of a certain shape and design and a five-pound flywheel of the same shape and design, would each have the same effect for the purpose of your patent; and you answered that it was very difficult to answer that without actually trying it out. Will you please state what you meant by that?

A. The physical property which is important in a flywheel for our situation is the amount of kinetic energy in a flywheel that can be stored. Now, this amount of kinetic energy depends, of course, on the speed of the thing, and as we have a rotating system, it depends on the number of revolutions per minutes and it depends on the distribution of the mass around the axis of rotation. To make a rather long theory short, I can tell the following. When I use a flywheel made of steel and I use exactly the same sized flywheel made of lead, both having the same speed of rotation

and the same shape and design, then the flywheel made of lead will have a very much larger moment of inertia than that of steel, because lead has a higher specific weight, and the parts of the flywheel being at the largest distance from the axis of rotation contribute most to the moment of inertia. Now, I like to emphasize here the point too that the dimensions of a flywheel necessary for our purpose depend on quite a number of factors. For instance, they depend on the angular velocity of the shaft on which the flywheel is fastened, that is, on the number of revolutions per minute. If I have, for instance, a shaft turning around with, let us assume, twelve revolutions per minute, and I have a second one turning around with twenty-four revolutions, then of course the speed of the second one is much higher and it is possible to store more kinetic energy in the flywheel; therefore, I might use in the second case a flywheel of smaller dimensions. As a matter of fact, when I am brought before the situation to decide which size of a flywheel I should use with a certain machine, I would apply the common laws of engineering which are taught in any course of technology and design of machines, and would calculate a flywheel having a certain amount of moment of inertia. I still better would apply a flywheel first and see what the effects are and would calculate its amount of the moment of inertia. If the action of the flywheel is not sufficient I would design one with another or a greater amount of moment of inertia, and so I would succeed finally in getting the right size flywheel.

RDQ. 861. Yesterday Mr. Neave asked you in substance, XQ. 523, if it was a fact that unless the perforations in the film were regularly spaced to fit the sprocket, you would have lack of constancy of motion even though you used a flywheel, and you answered, "If there was a certain looseness or if the

perforation distance was not coincident with the distance of the sprocket teeth, you could not have any constancy of speed even with the flywheel.'' I will ask you if you meant that the flywheel would not take care of any irregularities in the perforations?

A. The meaning of my answer was that the flywheel would take care of a certain amount of irregularities in the distances between the perforation holes; and I would like to add here that an arrangement as shown, as far as I remember in Figure 2 of the patent in suit. An arrangement like that would allow a still higher amount of irregularities in the distribution of the sprocket holes. The flywheel would overcome these larger irregularities, whereas in Figure 1 the irregularities in the distribution of the sprocket holes would be overcome too, but only to a certain extent.

RDQ. 864. I show you a picture of a tube taken from that same publication of Vogt's of 1926 that Mr. Neave showed you and ask you if you know what it is?

A. This is a photograph of one of our amplifying tubes. This type of tubes we used in the reproducing machine. We used them already in machines we showed in the year 1922 in the Alhambra Theatre. This type of tube is what nowadays is called a pentode. It is a five-element tube, an amplifying tube having a cathode and an anode, and three intermediary grids. One of these intermediary grids is the ordinary control grid. Another grid was used for space charge removing purposes, and the third grid was used for screening purposes. The third grid was located between the control grid and the anode. The arrangement which deals with a screening grid effect we applied for a patent on, as I remember, and I think an application has been made in the United States too.

RDQ. 865. I hand you a copy of U. S. Patent No. 1,587,786, Plaintiffs' Exhibit 26, and ask you what that is?

A. Yes. This is the patent relating to the matter I just told about, that is, an amplifying tube having screening means between the control grid and the anode. I like to emphasize the point here that these tubes, which give a very high amplification and are used everywhere now in receiving sets, that these tubes we had developed and used already in the year 1922.

MR. WARD: I offer in evidence the cut of the tube referred to by the witness and ask that it be marked in evidence as Plaintiffs' Exhibit No. 28.

(Cut of five-element pentode tube referred to by witness Engl, received in evidence and marked Plaintiffs' Exhibit 28.)

RDQ. 866. Mr. Neave asked you yesterday if the gist of the patent in suit consisted in arranging the flywheel at the translation point so that the movement of the film would be uniform at all times and, after some interruptions or discussion of counsel, he asked you what was the whole point of that, and you answered that the flywheel has to be applied at or in the vicinity of the translation point, and you went on to state that you showed in your notes where you got good results with the flywheel adjacent to the translation point. Will you please state what you understood Mr. Neave to be referring to in that question when you gave those answers.

A. I thought Mr. Neave questioned me about the situation of the flywheel in the patent just mentioned. Of course, I like to point out here that my meaning is that this patent contains more than just the answer to the question where the flywheel would be situated best. For instance, in this patent we show that the film should be run over a bent member, should be wrapped partly around a cylindrical or anyway a curved member. Secondly, the properties of the PE

cell play a very important role, because there is no sense in smoothing out irregularities in reproduction by using a flywheel when there are defects in reproduction created by a light-sensitive means, which does not give enough quality to be able to detect these irregularities in speed. Now, one moment, please. I would like to look over the description further.

Another important feature of the patent is the optical slit arrangement. I think that these what I pointed out are the most important features of this patent.

RE-CROSS-EXAMINATION (Resumed).

By MR. NEAVE:

RXQ. 868. You testified that you are now thirty-nine years of age?

A. Yes.

RXQ. 869. That means, according to my figuring, that in 1918, you were twenty-four years of age?

A. Yes.

RXQ. 870. Now, what about Mr. Vogt and Mr. Massolle; were they older men than you or younger?

A. They were older, yes.

RXQ. 871. About how much?

A. I cannot give you exact figures, but I guess Vogt is about five or six years older than I, and Mr. Massolle is about seven or eight years older than I.

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JOHN M. JOY, called as a witness in behalf of the plaintiffs, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. WARD:

John M. Joy; sixty; Yonkers, New York; engineer. I am now employed with the American Tri-Ergon Corporation, the plaintiff in this suit.

I am familiar with what is known as the Tri-Ergon apparatus for sound on film sound recording and reproduction. I first became familiar with it in July, 1926. I might state that my connection with the Fox Film was for the purpose of investigating various apparatus relating to motion picture industry and to find other apparatus that might be used in making the industry better. About that time there was considerable talk about sound pictures. And the future of them was more or less uncertain. Previous to that, in the fall of 1925, I heard about sound picture development being carried on by Mr. Case, of Auburn, New York. And some time during the fall of 1925 I visited his laboratory and his demonstration seemed to be very good, that it was brought to the attention of Mr. Fox, and some time later, in the spring of 1926, I should say, we decided to bring it down to New York for further investigation. I think that was in, we got down there about June of 1926. Numerous records were made in the studios there, and it was tried out in several of the theatres, not publicly, but privately, to determine just what the result would be in a theatre; and Mr. Fox decided to take it on and made an arrangement with Mr. Case, after which it became Fox-Case Corporation. And the product was named Movietone. In July of 1926 Mr. Fox's attention was again called to the Tri-Ergon system through a letter written by Mr. Schroeder, their representative in this country. We looked up the matter through all that was available in this country, and it seemed so interesting that it was decided to investigate it further. And I was sent to Europe for that purpose by Mr. Fox, arriving there some time in August, 1926. And from then till December I saw numerous demonstrations of the Tri-Ergon system, principally—I think entirely—in Berlin. The demonstrations were, in my opinion, quite satisfactory, and I advised Mr. Fox that

I thought he should secure an option on this system and bring it to the States and make some further investigations, some comparative tests with the Case system. And an option was secured, not only for the United States but for the entire world. And the apparatus arrived in the States the last of December, 1926. From that time on we carried on various tests and trials, recorded quite a large amount of film on various subjects, music and speech, in the Fox studios on the what was then the standard German sized film, forty-two millimeters. And as the result of those tests Mr. Fox decided to exercise his rights on the option for North America, with an extended option for the rest of the world. And I think it was in June, 1927, that Dr. Engl returned to Germany; Dr. Engl had been, during the period he was here, carrying on various tests and experiments to show the advantages of his system.

Dr. Engl had with him some of his German recorded film when he came here. He brought, I should say, five or six thousand feet of film recorded in Germany, on various subjects, music and speech. I remember distinctly there was a speech recorded of Stresseman.

I did not see any of the recording of that because it was done in Germany. I saw the reproduction of some of these films in Germany before we brought them over. And also at the Fox studios after the machine arrived here in December, 1926.

The quality of the reproduction was very good, being familiar with the Case system and having heard a great many reproductions of the Case system, that was something to compare the German quality with. It so appeared in Germany, to me, that the quality was very good. There were musical numbers, speeches, sort of—various kinds of musical instruments. And there was a farm scene with a sort of a traveling troupe

of musicians going through the country and playing at various farm houses; and the noises of the animals on the farm were introduced. Those noises seemed to be so faithfully reproduced and recorded that it was one thing that appeared to be an interesting thing for the motion picture future. In that film I remember especially that someone went out and pumped out a pail of water with an old-fashioned pump, and you could distinctly recognize the squeak of the handle working up and down. Exhibit 27-A and 27-B are different views of a reproducing machine which I saw in Berlin and which was afterwards brought over to the United States. That was the Tri-Ergon reproducing machine. It shows the driving motor and the amplifier, the batteries and so on. The machine that Dr. Engl brought over here was left here. The American Tri-Ergon Corporation owns the machine now. I might say—excuse me—that an additional head was sent over here; I think two—two additional heads were sent over. The sound head and the picture head are practically in one unit, built into the same casting. So the whole head, an extra whole head was sent over. When that machine came over here it was equipped for taking the German sized film. And it was proposed to try that machine out on the standard sized motion picture film. We thought it would be desirable to adapt it for what at that time appeared to be the standard which would be adopted for the American sound track, so that we could run Movietone film, which had already been recorded, in comparison with the result obtained with the Fox-Case reproducing apparatus. And that, in the latter part of Dr. Engl's stay here, that was hurriedly done, perhaps not the best design was worked out, but something was worked out to show that it could be changed very readily. By using the standard motion picture film I got the advantages of using what was practically

an American standard at that time, and which, as I recollect, was adopted afterwards, very closely, as the standard. The German film, I think the intention was to preserve the entire picture size, that is, the American track cut off a portion of the picture equal to the width of the sound track. That is, the Germans believed that the picture should be preserved and—this was a new development and nothing was standard—that the sound track might have more advantage to have it at such place as it would not disturb the size of the standard picture. I recall that as late as 1928 I happened to be in Germany and that much discussion was going on. I had many arguments with the German sound people as to whether or not they should change their track which they had been using and make it equivalent to the American standard, and they finally, for commercial reasons, decided to do that.

This photograph Exhibit 24 represents the changes made on the original Tri-Ergon machine. The sound sprocket was cut off and a portion to support the outer edge of the film was inserted in a bearing, the film being driven by the other part of the sprocket. The sprocket was hollow, kept just the same, the shaft going through the bearings was the same, and the flywheel mounted on it in the same way, and the photo cell was inserted into the hollow sprocket so as to bring the American sound track in correct position for being picked up by the light line. The light line was focused on that track with the same optical system. The light line was focused on the sound track by the same optical system. I don't remember that there was any change whatever in that. Simply a mechanical change to accommodate the dimensions of the American sound track, and probably some spacing pieces were attached to the gate to take up the difference between thirty-five and forty-two millimeters in the width. I will say that the sprocket spacing, that is, the pitch between the teeth, was al-

ways standard on the German machine, the same as the American pitch between the film holes.

The shape of the teeth in that machine, the sprocket teeth, was not the same as the shape of the American teeth. The Tri-Ergon had used a different perforation from the Eastman standard used in this country. In the German film the teeth were sort of conical shaped on the driving sprocket for the sound track, and the holes in the film were almost square. We still retained that. We did not disturb that special tooth on the sound sprocket and, of course, it does not fit the American perforations as it should have done. I stated that we cut off the sprocket which fed the film at the translation point. It was too long to bring the light line in the proper place. The distance from the driving sprockets, the light line was obliged to have no interference, no obstruction, to the light beam passing through the film on to the cell, so it was necessary to reduce the length of that sprocket and it was thought desirable to introduce a support on the outer edge of the film, although in the German film the edge overhung the sprocket and there was no support. Some sort of a support was put on for the American standard, because the overhang was, I think, slightly more. When I say I cut it to shorten it, I mean that I cut it transversely of the length of the sprocket, and took out an annular section of the sprocket drum so as to provide a proper space and proper position of the sound track for the light line to go through it. Simply a mechanical change. The outer sprocket was provided in one of the experiments, although later on I don't think we used a sprocket at all. We just supported the edge of the film on a roller. A smooth ring instead of a sprocket ring. I might say also that the motor is not the same as for that machine.

I think that the support of the PE cell is the same except that we used a clamp to clamp the cell on in place

of the screw which went up from the bottom of the support and screwed it on. The extent of its position inside of the hollow sprocket was practically the same, except that the cell may have been moved parallel to the axis in a different position to accommodate the different position of the sound track.

As to what we did about a different motor, this particular motor shown in this view is one that we put on which we had in stock, because we wanted something that would run on alternating current. This is a General Electric A. C. motor, sixty cycles, and runs at 1800 R. P. M., which is slightly higher than the speed of the machine, which should be driven at 1440. Therefore, we put a gear box in there, reducing that speed to 1440. That is all that it is. But at another time where we had direct current available, we used the original motor that was brought over. That was a 220-volt motor. I think this is about one-sixth horsepower. That is, the machine as brought over had a direct current motor on it. We changed to an A. C. motor because we had an A. C. source to use.

The rectangular looking object in the photograph is the gear box to reduce the speed of the motor from 1800 to 1440, I think it is. I have been referring to Plaintiffs' Exhibit 23.

This piece of German film, Exhibit 20, was originally a part of one of the films brought over here by Dr. Engl in December, 1926, and I clipped a piece of it off and found it in my files. I remember this particular subject of a man playing the cornet. That is the piece that I had in my files; I gave it to Mr. Haselton, I think. To the best of my knowledge the rest of this reel of film is destroyed at the present time. We had quite a large quantity of film, the result of various recordings by Dr. Engl, and also the German film which he brought over, stored in the vaults of the Fox Film,

and when Mr. Fox terminated his connection there, we allowed it to remain, and I tried to get it out several times, and there were various excuses about delivering it; and then last fall I made another effort and found that it had all been consigned to the junk pile together with a number of their own subjects. Therefore, it is not available and I don't know of any film that we have in this country at the present time other than short strips like that. As to whom I was with when I stored it, American Tri-Ergon, or Fox Film, probably. Yes, probably with Fox Film, with the Fox Film Company or Mr. Fox. The man in charge of the laboratory or the film vaults of Fox Film had charge or custody of it after I stored it there. I don't know his name. It may have been stored in Fifty-fourth Street building or Fifty-fifth Street. I don't know. I think it was stored in the Fifty-fourth Street building. Both were used or rented or owned by the Fox Film people. All film was stored there which was not in use. No, I don't think American Tri-Ergon at that time (1926) had any place of business of its own. I think the company was organized in 1928. So that it was really under my jurisdiction. I inquired about the film from time to time, and they said yes, they still had it. And I think the last time I inquired about it was possibly in October of last year. They had cleaned out a great deal of old film and this was mixed in with it and with some of their own subjects, they cleaned out when they went through the vaults. I do not know when Mr. Fox officially terminated his connection with the Fox Film Company. As to whether I attached any importance to these records, these German records, only as historical matter, perhaps; I might say that there were several records among those which had been recorded in this country and printed with the sound track in the standard American position.

Referring again to the time that Dr. Engl brought his machine over here and demonstrated it in the Fox Film studios, and as to whether I know anything about any other company having access to Dr. Engl's demonstrations and experiments, the Western Electric officials and engineers had access to the Fox Film studios. You are asking me about Dr. Engl's apparatus and demonstrations. As to what extent they had access, Mr. Cortlandt Smith, who was an executive in charge of the Movietone work, brought Mr. Otterson and Mr. Drake in one day and introduced them, I remember, to Dr. Engl and myself, and requested that they be shown everything in connection with the Tri-Ergon system. From that time on they had access. And numerous other engineers who came up there—I remember Dr. Crandall was in, and probably Dr. McKenzie was about there a great deal—because they were along perhaps in the summer of 1927, and they had permission to install their recording system in Fifty-fourth Street studios.

At that time I think these four gentlemen were connected with the Western Electric Company. Afterwards with The Electrical Research Products. That is their subsidiary. They were not merely shown the demonstrations by Dr. Engl. They were interested to see exactly what Dr. Engl had accomplished in the way of recording and reproducing sound pictures, sound on film. At that time, in August of 1926, the Warner Brothers had given one of the first sound picture demonstrations of any length in New York in a theatre, but this was with synchronized discs, called the Vitaphone, and they undoubtedly were trying to interest all producers to take this system, because it appeared to be something that would be connected with the future of the motion picture industry. But I know that Mr. Fox did not believe that the disc was the correct thing. Even though the quality may have

been good, he believed that the logical thing for picture work was one in which the sound was directly photographed on the film, so that you would only have one thing to handle. From a commercial standpoint it was much more practical, and he took that position and maintained it and never could be interested in using the disc. From that time on he very actively pursued the perfection and development of sound on film, and I think it was in the winter of 1927 that several short subjects were shown at the Harris Theatre in New York of sound on film. Previous to that time, I might say, possibly in—I don't know the year—Mr. Fox had tried out the DeForest system in one of his theatres, but the results were not good. I think that rather discouraged him as to future sound picture development.

These Western Electric engineers were allowed to inspect the Engl apparatus. As a matter of fact, Cortlandt Smith suggested that we form some kind of a committee which could meet and discuss these various things and have them explained by Dr. Engl and discuss the technical points involved, whether he had anything that they thought might be useful. It was an entirely frank proceeding at that time. And we did meet. The discussions were held. Dr. Engl explained things. He and Dr. Crandall had many discussions as to the optics of various arrangements used in both the recording and reproducing apparatus.

As to whether at the time that Dr. Engl demonstrated his apparatus and explained it to Mr. Fox's representatives and these gentlemen from the Western Electric Company, the Western Electric Company had put out anything to the public or commercially in the way of sound on film sound pictures as distinguished from these disc records synchronized pictures, I don't know of any commercial installation

that was in use, or even publicly demonstrated installation, and prior to the first showing that Dr. Engl made in this country.

As to whether I know of any experimentation carried on by the Western Electric people for the purpose of producing sound pictures and films after Dr. Engl's demonstrations to them, I heard that they were carrying on experiments in the laboratory.

I was not around the telephone laboratory, no. In the spring or early summer of 1927 I did actually know that they were experimenting with the light valve for recording, because at that time Movietone had become commercial, they would be given an assignment to record a subject that perhaps might involve several thousand feet of film; and I know that during some of those recordings, after the Western Electric's light valve system had been installed, they would perhaps record the same subjects; but in comparison with the work turned out by the Movietone, they were still in an experimental stage for some time there. They might get one good reel out of five or six thousand feet of film. I mean the Western Electric might, with their light valve. One reel that might be considered suitable for commercial reproduction or use. As compared with the results by the Movietone on the same subject at the same time, well, they usually expected to get at least 95 per cent. of their subjects suitable for commercial use.

The Movietone was the commercial name adopted for the Fox Film sound on film—Fox-Case—I beg your pardon; sound on film. The light valve installation of the Western Electric Company in 1927 was not a commercial installation. It was in the nature of a laboratory installation, I should say, installed in a motion picture studio in order to have the advantages of studio facilities.

As to whether the experiments of the Western Electric there at the laboratories were brief experiments or substantial and extended, oh, I think they carried on those experiments for many months. The apparatus was installed there. I don't know whether it is there now. I think it is there now; I am not sure. It was not a commercial apparatus; it was not bought because it was not a perfected commercial apparatus. But it was, as I said before, permitted there for the purpose of enjoying the facilities of a studio and a film laboratory.

Again referring to the time that Dr. Engl came over and demonstrated his apparatus in the Fox studios, at that time and as to whether the R. C. A. had ever presented to the public or put out any sound on film sound picture apparatus, I don't know of any of my own personal knowledge, or can't say that I ever saw one in operation. I don't know—I understood from various engineers that they were experimenting.

I was at a meeting at Norfolk, Virginia, a meeting of the Society of M. P. Engineers in May, 1927. Dr. Engl attended that meeting with me. The Western Electric exhibited sound motion picture apparatus there. They exhibited the Vitaphone, and they showed several short subjects and a paper was read by Mr. Rainey, who was one of their engineers connected with the development of the sound on disc apparatus. This Vitaphone was a sound on disc apparatus. And the paper read by Mr. Rainey was in regard to sound on disc. I did not see anything or hear anything there of any Western Electric work or apparatus, so far as concerned sound on film. I might say that Mr. Rainey was another Western Electric engineer who frequently came to the Fox studios.

Q. 82. In order to give the other side every opportunity to check up as to the possible existence of

any of this German film, that we are as anxious to locate as they are—if they are anxious—will you please state whom you inquired of about these films at the Fox people, who you think ought to know about it and whom you inquired of?

A. I inquired the last time of Mr. Leo, who was vice-president of the Fox Film Corporation and directly in charge of all laboratory work—all film laboratory work; and he told me that he had made inquiries of the proper people and that was the story that they told him.

That is, he was in that capacity before Mr. Fox terminated his relations. And he was the party who was in a position to control or know where those films were when I left there. I have also made other inquiries direct to people that are in charge there now who also were there at the time we stored the films; and they have substantially confirmed that.

In 1932, Mr. Vogt was not employed by the American Tri-Ergon Company. I think he wanted to be friendly with the American Tri-Ergon Company at that time. I was in Berlin from about the twentieth of March until the first of June, 1932, and during that time I saw Mr. Vogt several times, and I think it was in May he communicated with me first through Dr. Engl, that he would like very much to have a talk with me. So we made an appointment with Mr. Vogt and called on him at his laboratory. We discussed various matters and he brought up a subject which appeared to be very disagreeable to himself, and it was to us also. He stated that he had been approached by members of the legal staff of Electrical Research Products Company of New York, and they had asked him if he would consider permitting them to look through his files or to use his files, in which had been recorded various laboratory experiments, or other matters that might be useful to them in connection

with these suits over here. And he said that they had offered him a substantial amount of money for that purpose. I told him at the time that I was not prepared to even discuss it with him, that it was not a question of our trading with him against the Western Electric Company, but that I thought it was a question of ethics on his part to even consider such a thing, and I asked him to consider it from that standpoint. Several days after that he wrote me a letter in which he stated that these Western Electric attorneys from London had been pressing him again and wanted some reply as to whether or not he would permit them to make use of these files. We took the matter up with our attorneys in Berlin and they advised me that in Germany it was a serious matter for a person who had been employed by a corporation or by an individual to at any time thereafter disclose anything which might be of benefit to a third party or which may have been private matters; and they advised that we apply to the Court for an injunction prohibiting Vogt from making such disclosures. And we did. And the Court granted an injunction and we did not even use it with Mr. Vogt, because I considered him a man of high character, and I did not believe that he would be so unethical as to go against his former associates. And we simply held this paper and did nothing with it. I met Mr. Vogt several times afterwards and he wanted to interest us in some new developments relative to his loud speaker which he had been working on. And I distinctly told him that we might or we might not be interested in such a device, but that surely we were not going to purchase or trade with him as to whether or not he should disclose these matters to the Western Electric Company. And when I left Berlin on, I think, the first of June, our general counsel in Berlin told me that he had seen Mr. Vogt and had read the Court injunction to him

and that he was very much surprised that he was doing something against the law of Germany and which I understood is a criminal offense, as well as a civil offense. And the Court also said that this injunction could be——

MR. NEAVE: Wait a moment, please. Did you say "the Court also said"?

THE WITNESS: I want to say our lawyer.

MR. NEAVE: Have you got those papers here, Mr. Ward?

MR. WARD: That is hearsay.

Mr. Joy, have you got the papers here?

THE WITNESS: No, I have not.

MR. WARD: Have you got them in New York?

THE WITNESS: No. I have only Vogt's correspondence. The papers, of course, are in Germany.

MR. NEAVE: We never heard of this before, your Honor, and we have been through the cases on this.

THE WITNESS: I have the names of the two gentlemen who made these overtures to Mr. Vogt, at least so he states.

MR. NEAVE: Oh, there is no doubt about it. We tried our best to find out what the facts were, but they were concealed from us. But as to this court injunction, I know nothing of it and I object to anything; as he says, it was an injunction and a written thing and he has not got it. If he can get it I have no objection to it. But I object to his testifying to the effect of it, and so forth.

THE COURT: Yes. I would have to sustain the objection, Mr. Neave. The record being the best evidence.

These two photographs represent some experiments which we applied to the second sound head, carrying out the idea shown in one of the figures of the United States patent. This third photograph is the same combination. The film is shown in this view inserted in the machine.

(Photographs representing experiments applied to second sound head, as described by witness Joy, received in evidence and marked Plaintiffs' Exhibits 29, 30 and 31 respectively.)

Aside from the changes that I pointed out in that machine, those photographs represent that second sound head. As to the change made in this machine from the way in which it stood when we received it from Germany, we wanted to try some experiments with another type of machine such as was described in the patent, so we removed the gears driving the sound sprocket shaft, and drove the flywheel by means of the film wrapped over the drum. We removed the sprocket pins from the sound shaft so that it became a smooth drum, with the film going around it and, before making contact with the drum, it went under a roller and, after leaving the drum, it went over another roller before it went into the take-up sprocket; the idea being to roughly try out the theory disclosed, one method of operating the machine such as described in the United States patent. It represents Figure 2 of the patent in suit.

I place the numeral 1 pointing with an arrow to the smooth drum. I place the numeral 2 with an arrow pointing to the flywheel. The numerals I am now placing are on Exhibit 30; 3 and 4 on Exhibit 30 show spring-pressed rollers; 5 shows the support for the PE cell. The PE cell is central with the smooth roller 1. That is, it is within the axis of it. 6 indicates the sprocket taking the film from the smooth roller

and feeding it into the take-up magazine. 7 represents the sprocket feeding the film on to the smooth roller.

The American Tri-Ergon has still this machine shown in Exhibits 29 to 31. The motor shown on this machine is the identical large motor shown in the other German machine Exhibits 23 and 24. We simply removed one head from the base and substituted for it the other for convenience. And aside from these changes I pointed out took place on this machine, the movement of the film of Figure 2 of the patent, I don't recall any other changes.

Cross-Examination.

By Mr. Neave:

Portions of the machine as shown in these photographs Exhibits 29, 30 and 31, came from Germany, but not exactly in the form shown in the photographs. The machine shown in these photographs had a smooth roller over which the film passes at the point where the light is projected. And on the shaft of that roller there is a flywheel. The smooth roller, as I stated before, was made from the original one which was on there. I should say a short time ago, maybe a month ago. That was done under my direction. As to whether it was for the purposes of this case, I presumed so at the time, because Mr. Ward suggested that we make such a construction. This machine, which was first made in its present form a month or so ago, is not the first of that character with a smooth roller that I ever saw. I saw one in Dr. Engl's laboratory having a smooth roller. 1929, I think it was.

XQ. 118. With reference to the attempts that were made to get from Vogt, the facts bearing upon whether all of these patents were for inventions made by the three men or by one or less than the three, you

and your associates took steps to prevent that information being obtained, as I understand it?

A. Naturally.

XQ. 119. Why were you so afraid to have that information obtained?

A. We were not afraid. That was the position that I took, that anything that might be useful to you was already probably published, but Mr. Vogt seemed to consider the substantial amount of money offered him was quite interesting to him.

XQ. 120. Do you know what that substantial amount of money was?

A. Only from what he says.

XQ. 121. And you don't know what "substantial" meant to him?

A. He said it was substantial. It meant quite a bit to him.

XQ. 122. You or your associates employed Vogt, didn't you?

A. No, sir. Vogt has never been employed by American Tri-Ergon Corporation, or by Mr. Fox, or by any of my or his associates. None of us paid him for his loud speakers. We acquired his invention for loud speakers only through his assignment to Tri-Ergon, but he has been trying for some time to interest us in a further development of his loud speaker; in fact, he prepared a sort of an option arrangement whereby he would agree to restrain himself from disclosing anything in his files, but we have never considered that as a proposition at all. We did not negotiate with him for those things.

I know a Mr. Sponable. He was for some time chief technical man for the Fox-Case Corporation. Afterwards for Fox Film. In the fall of 1926 he was technical man in charge of Movietone. He was working for the Fox Movietone, the Fox-Case Corporation. I don't know of my own knowledge that Mr. Sponable

went to the General Electric Company's place in Schenectady in the fall of 1926. I did not go to the General Electric Company at about that time and see what their work was there. At that time I was in Europe. I have not been at Schenectady.

As to whether Mr. Fox was out of the Fox Company when I tried to get the films, such as this Exhibit 20, I had made inquiries about these films before Mr. Fox moved out, because I wanted to keep in touch with them all the time, and know that they were there. When I tried to get them Mr. Fox was out. I was somewhat familiar with Mr. Case's work in 1925. I went and saw his things. I know that Case had then successfully recorded sound and pictures on the same film. And I saw his sound recording and reproducing apparatus in 1925; he gave a demonstration in the fall of 1925. He was using a photoelectric cell, but he was using a physical—what we call a physical or mechanical slit. And in connection with that he did not have an optical system, lenses and so forth, not for the sound; for projecting the sound light beam on the film, to my knowledge he did not have one at that time. He was using as a light source a type of gas discharge light called the Aeo light. He was using the regular standard width film with standard sprockets. And he was using a flywheel on his machine. I could not definitely tell you whether it was intimately or closely associated with the point of translation. It was quite a large flywheel, I remember, driven by a belt.

XQ. 148. And all of that you saw prior to the time you went to Berlin in 1926, and prior to the time of Mr. Engl's trip to this country—and he arrived I believe in December, 1926—and prior to the time that any Tri-Ergon apparatus arrived in this country?

A. Yes.

I think the Fox-Case Corporation was formed perhaps in the fall of 1926. The Fox Film, I believe, had some interest in it. The Fox Film or Mr. Fox had the controlling interest in it.

As to whether I know that the Fox-Case Corporation acquired a Western Electric recording license as a sublicensee of the Vitaphone in December, 1926, I understood that they had been negotiating with Vitaphone a few days after my return from Germany. I understood then that negotiations were going on with the Western Electric people, Vitaphone, for the purpose of getting some rights under their amplification, of the Western Electric amplification system for purposes of producing sound on film pictures. I was given to understand that Vitaphone had acquired exclusive rights under Western Electric amplifier patents, and that such rights for other picture producers would have to be given with their consent.

I returned to this country in December, 1926. The Fox-Case Corporation did acquire a sublicense from Western Electric but what the license covered I don't know, because at that time the only thing they had to license were amplifiers and possibly microphones. I presume that the Fox-Case Company has a license from the Electrical Research Products Company at the present time. I don't know the date they acquired it.

MR. WARD: Will you give me those dates, Mr. Neave?

MR. NEAVE: May 10th, 1928, effective as of April 2nd, 1927.

XQ. 159. After the Fox interests had examined the Tri-Ergon apparatus, the Fox interests continued with the Case apparatus, didn't they?

A. Oh, yes.

As to whether the first sound pictures for Fox Film Company were recorded in New York in June,

1926, at the Fox-Case studios, there were some shorts made about that time. As to whether in that recording the Western Electric condensing microphones and the Western Electric amplifiers were used, possibly they were tried during that period. I don't think they were installed as early as that, because I am sure that Case brought down from Auburn the amplifier which he had been using there and also the microphone, and the first recordings were made with that apparatus. And at that time he was considering construction of an alternating current operated amplifier which could be attached to the standard AC line. I know that short subjects were produced at the Fox-Case studios in New York in 1926 and that they were shown publicly at the Sam Harris Theatre on January 21st, 1927. Possibly Western Electric amplifiers were used for reproducing there, but the other part of the equipment was Case reproducing machine. As to whether it was more than "possibly," I could not definitely tell you that, Mr. Neave, because if I did know I have forgotten. I know I was present in the auditorium and went into the projection booth many times, but I don't know whether it was Western Electric amplifier or the Case amplifier. I am quite sure that the Case was installed for the purposes of trying out the various units, and very likely a Western Electric amplifier was afterwards installed, because naturally they were looking to people who had made amplifiers to find out whether they were good enough at that time to carry on reproduction work. I had heard the reproduction from discs with a Western Electric amplifier at Norfolk at the Motion Picture Engineers meeting, and there was some criticism there as to its frequency range, and there was some discussion among—I think Dr. Engl and I discussed whether or not the frequency range of that amplifier would be as efficient for the future use of the sound on film.

The first all-sound program produced by the Fox interests was given at the Times Square Theatre in New York in September, 1927. As to whether I know that complete Western Electric sound on film reproducing system was used there, it may have been a sample one. How much of it was Western Electric is not possible for me to state. It probably is correct that nineteen Fox theatres were equipped with the Western Electric sound on film equipment by October, 1927, although I could not definitely state of my own knowledge at the present time that there were nineteen. I think that all theatres that had been equipped with sound on film were Fox theatres. No other. I know the Roxy Theatre in New York was equipped with the sound reproducing apparatus in July, 1927. That was Western Electric sound unit, with Western Electric horn.

I understand the Fox people have now gone over to the Western Electric light valves and dispensed with the Fox-Case glow tube.

I am employed by the American Tri-Ergon Company, as executive engineer.

XQ. 177. What do you do in that capacity? I never see you in anything except this litigation. Do you have other things to do?

A. Well, we have been quite busy in carrying on certain developments. I have been in contact all the time with Dr. Engl, who is carrying on sound picture developments in Berlin laboratory, and many matters over there that are enough to keep a person occupied.

XQ. 178. The Western Electric Company had fundamental patents on amplifiers which the producers were compelled to adopt in order to produce their motion pictures as there were no other amplifiers available; that is true, isn't it?

A. They thought so. They did adopt them.

XQ. 179. Well, you so testified, didn't you?

A. They did adopt them.

XQ. 180. There were no other amplifiers available?

A. Well, I think R. C. A. had amplifiers, or General Electric Company.

XQ. 181. I show you some testimony that you gave in Brooklyn, in one of these Tri-Ergon cases. In answer to XQ. 29: "They had certain fundamental patents for amplifiers." And then in answer to XQ. 30, you said, "They had amplifiers anyway, which the producers were practically compelled to adopt in order to produce their motion pictures. There were no other amplifiers available."

A. I meant there were no other amplifiers available in America.

XQ. 182. Well, this statement in that testimony is true?

A. Yes, that goes for that. But I want to modify it now, or give you the real meaning; I will say that there were none available in America. That is what I meant at the time.

XQ. 183. And in that prior suit you were asked: "And the Fox-Case Corporation acquired a Western Electric recording license as a sublicensee of Vitaphone, in December, 1926," and you replied, "I think that is correct. It acquired, if I may say, not recording licenses but amplifier licenses which were only part of the recording system"—end of quote. Is that testimony correct?

A. That is correct, they are only part of a recording system.

XQ. 184. Is all that I read there correct? Do you want to see it?

A. Yes, if you please.

XQ. 185. That is correct, is it?

A. Yes.

XQ. 186. Is that statement correct?

A. That is what I said.

XQ. 187. Well, you said that. But do you still stand by it?

A. I still stand by the fact that the amplifier is only a part of the recording system, and that you can't record with the amplifier alone.

XQ. 188. And do you still stand by your statement that the Fox Case acquired a Western Electric recording license as a sublicensee of Vitaphone in December, 1926?

A. I stand by my answer.

XQ. 189. And your answer is, quote: "I think that is correct. It acquired, if I may say, not recording licenses but amplifier licenses which were only part of the recording system." End of quote. Is that answer correct?

A. Yes, that is correct.

XQ. 190. When I was asking you about those nineteen Fox theatres equipped with Western Electric sound on film equipment by the latter part of 1927, you seemed to say, a few minutes ago, that you knew a large number were equipped but did not know that nineteen was correct. Is that what——

A. Yes. To my own knowledge, I don't think there were any other except Fox-owned theatres that were equipped with sound on film at that time, because there were no other producers that were far enough along to produce commercial film.

XQ. 192. In your testimony in Brooklyn you were asked this, and answered as follows: "And you recall that some nineteen Fox theatres were equipped with Western Electric sound on film equipment by the latter part of 1927?" "Answer: Why, I should say more than that; because the Western Electric had by that time gone into quite extensive production of the repro-

ducing apparatus." End of quote. Is that answer correct?

A. Yes. That is correct.

RE-DIRECT EXAMINATION.

By MR. WARD:

Mr. Neave asked me if the machine of the photographs, Exhibits 29 to 31 inclusive, came from Germany, and you understood me to say that it did not. I will now state what I have to say about that. The entire machine came from Germany with the exception of the parts put on here, showing the operation of Figure 2 in the United States patent. All of the parts came from Germany. The head is identical with the standard head so far as regards picture, and the same size flywheel. Every other thing was identical with the exception of the motor and, as I stated before, the motor was used to drive both types of sound reproducing mechanism. It came from Germany, except for the film movement corresponding to Figure 2 of the patent and the motor. It came from Germany in January, 1927. It was not shipped at the same time as the other machine.

RDQ. 197. Mr. Neave asked you at XQ. 118: With reference to the attempts that were made to get from Vogt the facts bearing upon whether all of these patents were for inventions made by the three men or by one or less than the three, you and your associates took steps to prevent that information being obtained, as I understand it. And you answered, "Naturally." Then he asked you: "Why were you so afraid to have that information obtained?" And you answered: "We were not afraid. That was the position that I took, that anything that might be useful to you was already probably published, but Mr. Vogt seemed to consider the substantial amount of money offered him was quite

interesting to him." What have you to say about that testimony?

A. Our principal objection to Mr. Vogt's disclosing information was relative to his laboratory notebooks or any data that he may have had in his possession that was obtained during his employment by Tri-Ergon or his association with the other two inventors.

RDQ. 198. Was the question of inventorship, as far as you know, raised by Vogt at the time that you had these talks with him?

A. Not at all.

This article of Vogt's that the defendants have referred to in this case was first shown to me by Mr. Neave in the court in Brooklyn during a trial there on another patent matter. That was the Paramount case which was tried last winter. I did not know anything of it at all, or Vogt's contentions at the time that I had these conversations with him in Germany. He never mentioned that any such paper had been published, any such article had been written by him. At that time I did not have any information or knowledge that the Western Electric people were trying to get him to state or establish that he was the sole inventor. We considered that that was already established in various contracts with the inventors. I do not mean by the answer that "that was already established," that he was the sole inventor. That he was the joint inventor with the other two.

RDQ. 204. Mr. Neave questioned you with regard to the situation of Western Electric amplifiers in 1927, and that the Fox people used Western Electric amplifiers when they went into commercial production in 1927. Will you please state just what the fact was?

A. Mr. Fox, Fox Film, were anxious to advance the art commercially and considered that the Western Electric were in position to turn out such apparatus

quickly as amplifiers, and that was one reason why they made use of them; and another was that it was impressed upon Mr. Fox and the organization that they controlled the amplifier situation through certain patents which were not free to be used by the public.

RDQ. 205. In your testimony to which you were referred in the Brooklyn suit, I think you made some reference to the fact that the Western Electric Company had a controlling patent or patents on the amplifiers. Have you any particular patent in mind that you were referring to there?

A. One patent was what is known as the Lowenstein patent for the use of a negative grid bias on the control grid. Then there were other patents which I do not have in mind.

That is the one which I particularly had in mind when I testified.

RDQ. 207. Do you know whether the Western Electric Company had these amplifiers worked out for their other work than sound reproduction?

A. I think they had amplifiers worked out for their public address system before 1926, and perhaps as early as 1922; but the amplifier which they were using with the Vitaphone disc installation, I could not tell you whether it was the same in detail as the public address amplifier.

RDQ. 208. Reference was made to the use of the light valve in the Fox studios and to the use by the Fox Company of the light valve. Will you please state what type of sound recording device the Fox Company was using up to the time that Mr. Fox severed his connection with the company?

A. They were using what is known as the Case Aeo light. It is a type of glow light, both in the field and in the studio.

RDQ. 210. Up to about how late did they use that? Approximately. I don't care about the particular time.

A. I think, of my own personal knowledge, it would go up to about the middle of 1930. I have talked with some of their engineers and they advise me that they were using it much later than that. Even in 1932.

MR. WARD: It is stipulated that the Fox Company in their recording work were using the glow light exclusively in the recording of sound pictures up to the last four pictures produced by them prior to last December.

THE WITNESS: I had occasion to observe the quality of the sound pictures put out by the Fox Company, in comparison with those put out by other people. Some of these other people used the Western Electric light valve. I should say the quality of the Fox sound pictures was just as good as that of these other people using the light valve.

This cut, Plaintiff's Exhibit 28, is an amplifier tube which was shown by Tri-Ergon in Germany when I went there in 1926. The same type of tube was brought over here for use in their amplifier when Dr. Engl came over in December, 1926. We tried out sound reproduction on the machine as shown in the photographs, Plaintiffs' Exhibits 29 to 31, showing a machine with the film movement of the sound head corresponding to Figure 2 of the patent in suit. I would say the quality of the sound reproduction was very good.

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WILLIAM C. BALLARD, JR., called as a witness in behalf of the plaintiffs, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. WARD:

Q. 1. Mr. Ballard, will you please state your name, age, residence and occupation.

A. William C. Ballard, Jr.; age forty-four; residence, Ithaca, New York; occupation, professor of electrical engineering, Cornell University.

Q. 2. Will you please state your qualifications as an expert in this art?

A. I was graduated from Cornell University in 1910 with the degree of mechanical engineer in electrical engineering. The course involving both mechanical and electrical engineering. During my course I spent two summers in the shops of the Baltimore & Ohio Railroad at Mount Clare, Baltimore, in actual work as a mechanic in the tool room, where high precision equipment is made; thus getting practical experience in accurate machine work. I was recalled to the university to teach in 1910, and the first year thereafter I was engaged in teaching in the department of machine design in the mechanical engineering department. And in the following year, 1911, I was called to teach in the school of electrical engineering, where I have been continuously employed at the university up to the present time, with the exception of certain leaves of absence granted to take up outside work, such as during the War, and consulting work since that time. I have been granted a number of leaves of absence to enter commercial work of one form or another, and in 1917 I was granted a leave to act as engineer with the National Electric Signalling Company of Brooklyn, New York. In the latter part of the War I was recalled to Cornell to take technical charge of the school for radio electricians operated there by the U. S. Army. In 1923 I spent some months with the Westinghouse Electric & Manufacturing Company, in East Springfield, Massachusetts, in the solution of various radio problems. And since that time I have been retained as consultant by the Westinghouse Company, the Atwater Kent Company, the Grigsby Grunow Company, the Western Electric,

Case Laboratories at Auburn, the Fox-Case Company, and the American Tri-Ergon Company. In 1923 I became interested in sound on film sound picture matters through work in the laboratories at Cornell. And between that time and 1926 I made frequent trips to the Case Laboratories at Auburn, New York, where Mr. Case was developing sound picture apparatus, and where I first inspected and consulted with Mr. Case on his sound on film picture sound picture development work. In 1926 I entered into a part time agreement with Mr. Case to devote a considerable portion of my spare time in assisting him in the development of sound pictures. And during this employment I spent a great deal of time in connection with the development of sound picture apparatus involving sound on film. The system that Mr. Case was using was the one involving the Aeo light, which is a form of glow light for the recording of sound on film. This recording method produces what is known as a variable density record on the film. For reproducing the sound from the film, Case's system employed a photoelectric cell, and both for recording and reproducing he used in the optical system the physical slit through which the line of light was projected on the film. In the latter part of 1926 or early 1927 Mr. Case made an arrangement with Mr. William Fox, which resulted in the formation of the Fox-Case Company. This company, I believe, was the first one in this country to successfully commercially record sound on film and reproduce sound from film by the use of photographic sound record as distinguished from the use of discs for recording and reproducing sound. In saying that the Fox-Case Company was the first to successfully commercially use this, I have not overlooked the efforts of Dr. DeForest in New York in the year 1923, when he gave a few theatre performances, because I do not regard his results as

commercially successful, even at that early date. I have compared some of DeForest's film records with those of Case, at the Case Laboratories, and found the Case records far superior. And I think it is the general consensus of opinion that DeForest's work was not regarded as satisfactory. After the formation of this company some of the Case development work was shifted to the laboratory in New York City, and then I worked at both places; that is, at the New York and Auburn laboratories in the further development of the system. By reason of this work I became thoroughly acquainted with the various phases of the recording and reproducing of sound pictures to and from the film, and I have remained active in connection with the actual development work at these laboratories until 1930, when my connection with these organizations ceased. In connection with the work done for the Fox-Case organization, it was necessary for me to set up recording and reproducing equipment at my own private laboratories at Cornell, and I have recorded many thousand feet of film, personally recording, developing and reproducing. Since then I have kept abreast of the development of this art by reading the literature and patents and by examination of different machines put out from time to time. I have read hundreds of patents issued on the subject and have experted in several patent cases in this art of sound on film sound pictures. I might mention that I was employed as an expert in a suit in the Second Circuit, brought by one of the DeForest companies against the Fox Film Company on several patents on sound picture apparatus. I was also retained by the Western Electric Company as an expert in the defense of the suit which it defended in the District Court in Delaware, brought by one of the DeForest companies against the Stanley Company. I was also employed by the American Tri-

Ergon Company in a suit in the District of Columbia pertaining to sound pictures reproduction, and in another suit in Delaware, and in a suit in Brooklyn tried last winter against the Paramount Company. All of these suits involved sound on film apparatus or methods. I have been interested in music for many years, in both an amateur and professional way. I began the study of pipe organ harmony and composition in Baltimore before entering college, and later derived a considerable part of college expenses from playing in bands and orchestras. I was chief musician of the university band for several years. I have played pipe organ for about twenty-five years and am now completing the sixteenth year of service in the First Presbyterian Church in Ithaca, the largest church in Ithaca, and which maintains a choir of seventy voices. In 1919 and 1920 I was employed by the department of music in Cornell, to teach harmony, composition and musical theory in the Cornell summer session. I hold membership in various technical societies, several honorary fraternities. I have written a book on radio telephony, which has been published through several editions and been translated into a foreign language, and have been an occasional contributor to the technical press.

Q. 3. Professor, are you familiar with the patent in suit?

A. I am.

Q. 4. And are you familiar with the two machines styled PS1 and PS16, against which this suit is directed?

A. I have inspected them and am familiar with them.

Q. 5. Will you please take the patent in suit and explain the invention and apparatus there to the Court?

A. This patent relates to the art of photographically recording and reproducing sound on film, utilizing

a very fine line of light for recording the sound, and for reproducing it from the film by the use of a light-sensitive cell. The patent covers both apparatus for producing these results and methods by which it may be accomplished. One feature of the patent provides for so controlling the movement of the film as it passes the point of translation—that is, the point from which the sound is reproduced or at which the sound record is made on the film—that it is practically free of irregularities of motion. This is but one element of the patent, because if other contributing conditions are not maintained in proper relation, the uniform motion of the film does not attain the result that may be desired.

It provides in this connection for the use of a fine narrow line of light transverse to the motion of the film, for recording sound on the film, and to be used in reproducing the sound from the film as the light is allowed to pass through the film and impinge on the reproducing photoelectric cell.

The question of uniform motion in the reproduction of sound, the necessity for uniform motion in the reproduction of sound, has been recognized for many years, and early types of sound reproducing devices have had various means, various attempts to maintain the speed of the record carrier at a more or less uniform speed. Consequently, at line 13 of the specification, page 1, it says that speed regulators have in the past been proposed and used with gramophones and phonographs. That is, the source of the driving mechanism is made to operate as uniformly as possible. In the course of the driving mechanism many irregularities may be introduced by gears, slipping friction drives, and various other items, and it frequently happens that even though the driving mechanism may be operating at a constant speed, that the record is not moved at sufficiently uniform speed past the translation

point. This is taken care of automatically in cases of the better known phonographs, such as those which use discs and cylinders, due to the fact that these discs and cylinders and the parts which support them have a certain amount of inertia, and the inertia effect tends to iron out irregularities that may be produced in the driving mechanism.

Unfortunately in the case of sound on film records the inertia effect is very slight. And the patent goes on to say that there are some other cases in which the strip records are of little inertia, such as those used for magnetically recording sound. In this case the record would be a wire.

According to the invention the uniform motion is greatly improved by providing means and methods whereby a rotating mass may be caused to move in exact conformity with the record as it passes the translation point, and the patent is largely devoted, to some extent among other things, to means by which this result may be accomplished. Another feature of the invention——

Q. 6. You say the rotating mass is arranged to move in exact conformity with the carrier, or vice versa. Is the carrier moving in exact conformity with the mass, or the mass with the carrier?

A. I had not thought that there was very much difference in that statement. It depends somewhat upon which way you look at it. May I have my answer read?

(Record read by the stenographer.)

A. (Continuing.) If I may say, in correction of my statement, that I would prefer to have it read the other way around: that the record moves in conformity with the motion of the rotating mass, although I do not believe there is much difference.

Q. 7. Now proceed, please.

A. There are several embodiments of this invention. Figure 1 illustrates a system by which these results may be obtained. While this invention is not specifically limited to use with accompanying pictures, it is, however, very easily adapted and provision, as I think your Honor will see, is made throughout the invention, so that pictures may be reproduced simultaneously with the sound record.

Figure 1 indicates one way in which the uniform motion may be improved, in which the film enters the system at the lower left-hand corner, passes up under the roller $dr_1$, over a portion of the sprocket wheel $r_2$, past the photoelectric cell and the impinging narrow line of light which we will refer to as the point of translation, over another roller $r_1$, and back down again, engaging with a different portion of the roller $r_2$, and so on out. It being held into engagement with the latter portion of $r_2$ by the roller $dr_2$. To rollers $r_1$ and $r_2$ flywheels may be attached either to one or both of these rollers. Each pair of rollers and flywheels may be connected together by suitable belting or gearing. The film in passing through the system is given the inertia effect of the flywheel masses which are shown on the enlarged drawing in red for identification purposes, and thus the irregularities of motion which may have been produced in other parts of the system, are reduced or entirely eliminated.

In Figure 1 it will be noticed that the film leaves the sprocket teeth in its passage to the translation point to the left of the lower toothed roller, and unless the perforations of the film are exactly matched to the spacing of the sprocket teeth, there is sometimes a fluttering of the film as it disengages from these sprocket teeth introduced into its motion. That is particularly noticeable in film records that have had the opportunity of shrinking. The celluloid backing of the film does contract with age, and although it may have

been perforated perfectly originally, sometimes these perforations shrink and the fit on the standard sprocket wheel is less perfect than at other times. This lack of perfect fit of the sprocket teeth may introduce irregularities which will be transformed into vibrations at the translation point and, for that reason, an alternative system is suggested as shown in Figure 2, which eliminates the fine vibrations due to sprocket tooth disengagement to a very large degree.

Here the film enters, at the lower left-hand portion of this drawing, and passes over the sprocket V, is pressed upon by the spring supported rollers $dr_1$, and finally passes over the smooth roller R, leaving it on the right-hand side under the spring pressed roller $dr_2$, and finally under and passed out of the system under the sprocket V2. Here any slight fluctuations in the motion of the film that might be introduced by improper disengagement with the teeth are largely absorbed by the elasticity, the elastic action of the roller $dr_1$, and the same is true with regard to irregularities produced by sprocket V2, the elastic roller $dr_2$ acting as a buffer between the sprocket wheel and the point of translation.

This system in Figure 2 is designed to give the effect of the rotating flywheel which here is marked m and, at the same time, to eliminate to a considerable extent the fluctuations due to tooth disengagement. Figures 3 and 4——

Q. 8. Before you go to Figures 3 and 4, will you please point out the cooperation of engagement of the film on the roller R with the spring pressed rollers to smooth out those vibrations.

A. You are referring now to Figure 2?

Q. 9. Figure 2, the one you are on.

A. The spring pressed rollers, $dr_1$ and $dr_2$, cooperate with the flywheel in order to reduce or eliminate irregularities due to improper tooth engagement.

If there is a slight tendency for irregular motion here at the sprocket V, such irregularity is absorbed by the motion of the spring pressed rollers due to the elasticity of the system and does not reach the uniformly rotating smooth cylinder R, which is rotating uniformly under the control of the flywheel mass m. In other words, the irregularities set up in the sprocket V are not allowed to react upon the film as it passes the translation point on the upper part of the roller.

Q. 10. Will you point out the manner in which the line of light reaches the PE cell in that structure?

A. The patent provides that the roller R, Figure 2, may be made transparent and extend the full width of the film, in which case the light would have a chance to pass down through the sound record on the film, through the transparent roller and into the photoelectric cell which is located inside of the roller, the photoelectric cell of course being stationary, and the roller revolving around the photoelectric cell, and thus be transformed back into electric current variations. Or the film may be allowed to overhang the roller. The roller may be of less width than the film, thus allowing a free edge to overhang and allow light to impinge, to penetrate the free edge. It is difficult to see it from this drawing (Figure 2, large drawing) but it is described in the specification.

Q. 11. In Figure 2 how is the flywheel rotated. What causes the flywheel to move around?

A. The flywheel is kept in rotation by the action of the film itself in passing over this smooth roller R. The film drives the flywheel in Figure 2.

Q. 12. And what is it that keeps the film tightly engaged with the roller R to cause it to drive the flywheel?

A. The spring pressed rollers $dr_1$ and $dr_2$ producing tension on the film, keeping it tightly pressed around the upper half of the roller to drive the flywheel.

Q. 13. So that as the film travels the flywheel is caused to run?

A. Yes.

Q. 14. If the flywheel were not there, if you simply had the rollers $dr_1$ and $dr_2$ operating on the film, would that give you constant speed of the film?

A. No, there would be no method, no means provided to iron out irregularities, and the rollers would not produce constant speed. It is the cooperation between the spring pressed rollers, and the mass of the rotating flywheel which produces the constancy of speed.

Q. 15. Is it better or less preferable to have the film passing over a smooth roller, connected with the flywheel, and the driving sprocket located elsewhere or to have the film passing over a sprocketed roller on the shaft of the flywheel with the driving sprocket elsewhere, that is, is there any advantage in having this a smooth roller rather than a sprocketed roller?

A. Yes, there is a very distinct advantage in having this a smooth roller, because then there can be no possibility of irregularity due to tooth engagement introduced. The smooth roller can only iron out irregularities, and can of itself introduce none.

Q. 16. Reference was made here, this morning, I believe, to the fact that irregularities in the sprocket perforations—perforations in the film as contrasted with the spacing of the teeth of the driving sprocket, would cause irregularities which the flywheel if put on a toothed driving sprocket, would not entirely take care of. What have you to say with respect to the situation or functioning of the apparatus shown in Figure 2 as taking care of irregularities or not taking care of them where there is this difference between the sprocket perforations and the sprocket wheels?

A. From the very nature of the construction of Figure 2 it should be evident that such irregularities

are much more effectively taken care of with this combination than there would be if the film were caused to pass over a toothed roller in place of a smooth roller. This should eliminate irregularities due to tooth engagement, to a very large degree.

Q. 17. Now will you kindly refer to Figures 3 and 4 of the patent.

A. Figures 3 and 4 of the patent show several new features. In this case it is illustrated how the film may be caused to overhang the sprocket and allow the light to pass through the overhanging portion down into the photoelectric cell. This view to the left (indicating on large drawings of Figures 3 and 4) is a sectional view of the apparatus shown on the right. In this case the drum over which the film is carried is a toothed drum—toothed sprocket, as we may say; the teeth are not shown on the right-hand view, for simplicity; they are shown on the left-hand view. And the record projects beyond the sprocket and allows the light to pass through it on to the reproducing photoelectric cell. e and g represent two rollers which are located so as to force the film into engagement with the sprocket teeth at approximately the point at which the film comes on the sprocket. And therefore, any vibration which may occur below that point of engagement is ironed out and is not transmitted over to the point at which the light acts to translate the sound from the film.

The same is true in action as regards the roller g. It prevents irregularities of tooth engagement from affecting the motion of the film at the translation point.

The rotating weighty mass or flywheel is marked here as i and illustrated by being colored red on the two views.

Q. 18. Now, you referred to the fact that the rollers e and g prevented any vibrations outside of their

contact with the roller d reaching the translation point. Will you please state whether or not they assist any in helping to take care of any irregularities that may occur between their points of contact with the roller d.

A. Yes, they hold the film into engagement with the roller and thus cause the film to move uniformly with the motion of the toothed roller d.

Q. 19. That is, they assist in smoothing out any irregularity in the movement of the film which would be due to the sprocket engagement with the film holes from the contact point of one roller to the contact point of the other roller?

A. Yes.

Q. 20. Now, in connection with those Figures 3 and 4, Professor, will you please point out to the Court the optical slit arrangement and which is the width and thickness of the line, and how its light is transmitted through the film.

A. The light is thrown onto the moving film in the form of a line of light. In commercial machines today the line of light is approximately eight hundredths of an inch in length, or thereabouts, and approximately one-thousandth of an inch in width. This, of course, being an enlarged view, it is difficult to show the beams converging to a breadth of one-thousandth of an inch on the film, but I think your Honor will see that the draftsman has attempted to cause these beams to converge into a small and as narrow line as possible. In this case the length of the line is many times—somewhere around eighty times—the width of the line, and the long dimension extends transverse to the film, while the small dimension extends longitudinally of the film. I think your Honor can perhaps better appreciate the dimensions of these lines—may I have a sheet of white paper—I ask you to look at these lines through a magnifying glass on this strip of film, which has been

marked Exhibit 21; and I think on close inspection, sir, you can see that these lines of light, which extend about a tenth of an inch in length, and the thickness of these individual lines is extremely slight. Some of these lines are probably not over one one-thousandth of an inch in the direction measured in the way in which the film is moving, longitudinally of the film. It really requires a high-power microscope to get the full view of these lines. They are extremely fine and delicate. And the dimensions of the perfected optical system is such as to allow only one of these black or white lines to be illuminated at any particular time as they pass through the reproducing system. I think it can be readily seen that if the line of reproducing light were, say, two-thousandths of an inch wide and we were trying to reproduce a black line one one-thousandth of an inch and a white line one one-thousandth of an inch, there would be a blurred effect, because the black and white lines would be illuminated simultaneously and we would get an average between the two and would not distinguish between the shut-off of light due to the black line and allowing the line to pass through when the white line is under the translation point.

Q. 21. Now, will you briefly explain to the Court, please, how it is that uniformly with the constantly traveling film you are able to record the light lines as separate little lines, rather than just get a smear all the way down the film?

A. In order to record distinctly these very fine black and white lines—and I use white in the sense of "transparent" rather than white in the actual sense; because the lines are not white; they are merely transparent—it is necessary to have the co-operation between two different elements. In the first place, the light-line must be focussed down at least to a dimension smaller than the width of the finest line which it is de-

sired to record; and in the second place, the source of illumination must be capable of being vibrated and controlled at a sufficiently rapid speed so that it can vary from brilliant illumination to darkness—we will say—during the time at which this film may move a distance, perhaps, of a thousandth of an inch. There are two features involved, both of which are necessary. One is an inertialess light-source, and the second one is the focussing of the light down to a line of very small dimensions.

Q. 22. And is that where the importance of the light-source free of inertia comes in?

A. Yes, that is true.

Q. 23. Now, if you had the light focussed as it is shown and as you say it should be, to a fine line, and you had your inertia-free light-source for the recording, would you get desired results if the movement of the film past the translation point was not uniform?

A. No. There would be no desired co-operation between these other two elements which I have just described, unless the movement of the film is uniform past the translation point. If there is the slightest variation in speed, perhaps the part of the film which should receive a black line will be recorded with a white line, and vice versa. The motion of the film must be uniform, not in the general sense of so many feet per minute, but so many thousandths of an inch per thousandth of a second. It is an entirely different proposition from what we in many cases think of as uniform speed.

Q. 24. You are dealing with irregularities in speed which correspond to a width of a thousandth of an inch——

A. That is quite true.

Q. 25. —in thickness or in the direction of travel of the film.

A. That is quite true.

Q. 26. In saying that the lines are about a thousandth of an inch in thickness, that means that how many of those lines may be gotten on a linear inch of the sound film?

A. Well, if we allow an equal space between white and black lines, then we can have five hundred black and five hundred white lines in a linear inch.

Q. 27. In one inch?

A. Yes.

Q. 28. That is just a rough average, according to the thickness of the lines. Each line varies more or less in density according to the acoustically modulated light?

A. Yes; that is true. We should not have limited our statement to lines one-thousandth of an inch; because in many cases today lines of less than one-thousandth of an inch are recorded.

Q. 29. I only use that as rough approximate average.

A. That is just a rough approximation.

Q. 30. Now, you referred to the fact of what the drawings showed in Figs. 3 and 4. I would like to ask you if the drawing in Figure 3, where the light is shining through the film, does that intend to illustrate the direction of the length of the optical slit?

A. Yes. This illustration to the left of Figure 3 shows the length of the line of light, while that to the right of Figure 4 shows the width of the line of light.

Q. 31. Now, will you please refer to the specification, point out where that line of light is discussed.

A. This line of light is mentioned in a number of places in the specification. Attention is called to it in line 55, page 1: "Also, according to the present invention, a dependable and highly efficient optical system is provided for use in conjunction with moving film strips of the above indicated character."

On page 2, beginning at line 42: "The light rays required for the illumination or the transmission of light through the film are thrown upon the film in the form of a narrow line by means of the objective o."

Q. 31a. Will you also look at page 3, about line 33, I think?

A. On page 3, line 33: "The light collected by the object glass o to a narrow line, comes from a suitable known means or source of light-projection so arranged as indicated, for example, by the dotted lines in Figs. 3 and 4, that the converged narrow line of light is substantially focussed or impinges upon the area of translation t on the film as a line running transversely of the direction of movement of the film."

Q. 32. Now, will you please refer to the use of the line of light in reproduction, which is really what is shown on the Figures 3 and 4 here?

A. For the purposes of reproduction the source of light which gives the fine focussed line on the surface of the film is arranged to be as bright as possible and to be of unvarying intensity. And as the film passes under this narrow line of light, more or less light is allowed to pass through the film and onto the photo cell z, according to the degree of blackening that is present at that particular part of the record.

Q. 33. That is, the sound track with the little lines of different degrees of blackening, pass right in this line of light, and they let the more or less light through according to what the density of the lines are?

A. Yes. A black line of course shuts off most, if not all, of the light. And where the line is transparent —a white line, it allows the light to pass through relatively unimpeded.

Q. 34. The result of that is that the light that is passing through the film onto the photoelectric cell is varied in what way? What do you call it?

A. Acoustically modulated, providing of course that the record is a sound record. It is modulated in exactly the same way that the air pressure was modulated when the original sound was transmitted, when the words were spoken or the musical instruments were played. A black line on the film may correspond to a momentary condition of a pressure wave in sound, and a white line may correspond to a condition of rarefaction wave in sound.

Q. 35. Now, will you please state briefly the construction and operation of the PE cell which is used and its properties in relation to that use.

A. The photoelectric cell in general is composed of a glass container, some transparent glass or some other transparent material—sometimes they are built of quartz,—in which two electrodes are located. One electrode, which very frequently consists of a thin metallic coating on the walls of the glass, in this case indicated in Figure 3 by l, is given a coating of some material which is known to have photoelectric action. The electrode p, although not very well illustrated here, usually consists of a single wire with a loop on the end which may be made of almost any conducting material. The material of the electrode p is relatively unimportant. When light impinges upon the lower surface l, impinges upon the thin coating of photoelectric material, electrons are given off, with the net result—I won't try to go into a technical discussion of what is happening—with the net result that an electric current will flow in this space between l and p, corresponding very closely to the amount of light which is allowed to pass through the film, and that current is treated in a suitable way, magnified up, and finally serves to reproduce the sound.

Q. 36. That is, the PE cell all during this operation has its cathode and anode connected up in an electric circuit?

A. Yes.

Q. 37. What effect has the illumination or lack of illumination on the PE cell got to do with the variations of the current and its circuit?

A. The current variations are proportional to the variations in light impinging on the cell; in other words, this system is one which transforms a fluctuating light into a fluctuating electric current so that it can be utilized to work through telephonic apparatus, to produce sound.

Q. 38. What are the properties of the photoelectric cell for this use?

A. The photoelectric cell is extremely valuable for this use, because within the range of rapidities of vibrations which are necessary to be reproduced in sound work, it has practically no inertia. It has no effective inertia within that range. It operates immediately upon the changing of the light. There is no lag, fatigue, persistence, or any other characteristic of that kind, such as was found to exist in earlier types of sound reproducing light-sensitive elements.

Q. 39. What about its proportionality of the illumination and current output?

A. The photoelectric cell is operated under such conditions that the proportionality between illumination and current output is substantially exact. Certain photoelectric cells have the characteristic of having this proportionality exact over the entire operating range. Others have to be limited within a limited set of electrical conditions in order to obtain this condition.

Q. 40. Which is the usual type?

A. Both types are used.

Q. 41. Now, what about the property of fatigue?

A. A properly prepared photoelectric cell does not have fatigue. It gives the same response, whether it has been in use for ten minutes or for ten hours.

Q. 42. Having the sound properly recorded on the film, by proper recording light and proper uniform movement of the film, and having the photoelectric cell for the reproduction from that film, will you get proper reproduction if the movement of the film is not uniform?

A. No. If the movement of the film is not uniform, either in recording or reproduction, the proper result will not be obtained.

Q. 43. And if you have uniform movement of the film through the reproducing machine but you do not have the photoelectric cell, will you get proper reproduction?

A. No. These elements are dependent upon one another to give a proper overall action.

Q. 44. Now, will you please refer to those parts of the specification which describe the PE cell? You need not refer to all of them.

A. There is a description of the photoelectric cell on page 3, beginning about line 26: "The light . . . must pass through the film and fall upon a light-sensitive element, for instance, the cell z with the cathode l and anode p." Referring to the cathode and anode as illustrated in Figure 3 and other figures. This is in distinction to sound reproducing cells of the selenium cell type, which had no separated anode and cathode.

Q. 45. Will you read as to the location of the cell, referred to at page 2, lines 49 and 50.

A. "The photo cell z preferably placed in the interior of roller R." In this case, in Figure 3 the roller is lettered d, and R is the designation in Figure 2. The photo cell in Figure 2 is indicated as z.

Q. 46. It is indicated as z in all of the figures?

A. Yes. The roller seems to have different identification marks.

Q. 47. Will you point out the construction and operation of Figures 5 and 6?

A. The feature embodied in Figures 5 and 6 is described beginning lines 67, page 3: "If the driving shaft of the tone-film revolves with a low number of revolutions and if a rigid drive is used, the circumferential speed of flywheel s which can be practically utilized, will, under certain conditions, not be sufficient for compensating the speed fluctuations.

"According to the invention, the driving of the flywheel axle is therefore effected with the aid of an elastic coupling, for instance, a spring. This spring can be very feeble as, at constant speed, it has to overcome only the losses from friction of the driven part. As however, at the starting and stopping of the driving mechanism, the inertia of the flywheel has to be overcome, it is advantageous to limit the play of the spring in either direction by a fixed stop."

The embodiment here described in the specification is illustrated in Figures 5 and 6. As your Honor will see, on the same axial line with the main flywheel, a driving member 2 is located, this being driven by the gear wheel h'. Instead of being directly connected with the flywheel, as in the case of Figure 3, the driving member drives the flywheel through a coil spring, which is here shown as a coil spring in this particular embodiment, 3, on Figure 5. There are many advantages of the elastic drive. As the patent points out it allows a somewhat better filtering effect to be accomplished with a smaller and lighter flywheel. The action back of this is, of course, that the flywheel may continue to revolve at absolutely constant speed while the driving motor may be fluctuating slightly in speed, and the fluctuations taken up by the elongation or compression of the spring 3. In other words, it allows the flywheel to continue its uniform motion, even though the driving mechanism may have a certain ir-

regularity of motion, and the action is taken up in the spring 3. Such an arrangement does not exist, of course, in Figures 3 and 4 where the flywheel is rigidly connected to the driving mechanism.

Q. 48. Will you refer to the specification dealing with Figures 3 and 4, and with 5 and 6, in so far as they are the same in the four figures, and read the part commencing at line 90 of page 2?

A. (Reading.) "These rollers e-g press the film strip firmly against the cylinder d so that it lies, without possibility of being shifted, upon the entire peripheral length of cylinder d from g to e, because of the feed teeth of cylinder d engaging with the perforations of the film. The engagement and disengagement of the feed teeth on cylinder d, with the perforations of the film, takes place under the pressure of the rollers g and e, Fig. 4, so that vibrations or jerky motions of the film band, due to such tooth engagement or disengagement, no longer make themselves felt at the point of light projection through the same."

Q. 49. Is that what you had reference to in your explanation of these rollers and the action on the film?

A. Yes, that is what I intended to say.

Q. 50. What is meant by "without possibility of being shifted" in those lines?

A. The rollers press the film down to the base of the sprocket, and the film is held in place by the sprocket teeth in addition to the pressure exerted against the film by these rollers.

Q. 51. Have the rollers any effect in seating the sprocket holes on the teeth in any different way than if they were not there?

A. Yes, the effect of the roller is to press the film so that it seats itself, or that the perforations are seated at the sprocket teeth.

Q. 52. I refer you to a statement in the specification at page 2, line 105, and ask you if you will read that and state what that refers to?

A. (Reading.) "The free ends f-f of the film band are preferably guided by rollers (not shown) for preliminary winding up in the manner well known in picture cinematography, so that they form a loop."

Q. 53. What does that word "preliminary winding up" mean there?

A. I interpret that to mean that the film is threaded up. I interpret the word "winding" to mean "threading up." That is, wound around the rollers. In common United States American parlance, we speak of that here as threading up rather than winding up, so that a loop is formed between these two free ends of the film marked f and some other roller not shown as specified in the specification.

Q. 54. Now, Professor, will you take the charts of the defendants' structure——

A. Before you do that, Mr. Ward, there is one other item that I neglected to mention, if I may have the opportunity to do that now.

Q. 55. Very well.

A. The Court will notice that the film in Figures 2, Figures 3, 4, 5 and 6, is curved at the translation point, and there are certain special features in connection with the photographic film that make this a very desirable condition. I may point out at the start that with this line in Figure 2 shown here focussed to an extremely small width, say, for instance, one-thousandth of an inch, if the film is moved upward one-thousandth of an inch or down a thousandth of an inch, the width of the line will probably be increased by 100 per cent. or some given percentage; in other words, a very slight deviation up or down from the normal focussing position will increase the width of the line and completely—partially if not completely—defeat the purpose of the fine line of light.

A. (Continuing.) If the film is not perfectly flat transversely at the area at which the light is impinged

upon it, if the forward edge, we will say, is slightly lower than the back edge, one part of it will be in focus and the other will be out of focus and, instead of having a narrow parallel line of light, we will have one which comes to a sharp edge at one end and extends at the other end. So it is extremely essential that at the point of translation the film be perfectly flat transversely in order to realize the properties of the narrow line of light. Photographic film, such as these records are made upon, is composed of a celluloid backing and a gelatin emulsion upon which the photographic material is coated. When the gelatin emulsion dries it in general occupies a slightly smaller area than the celluloid backing of the film, with the net effect that the film has a tendency to curl. This characteristic is well known, not only in motion picture films, but films used for kodak work and other purposes.

I think your Honor can see that the piece of green film which I hold in my hand has a distinct characteristic to curl in the latitudinal direction. One of the properties of the film is that it can curl at one time only in one direction; that is, if we place it around a curved surface, we take out the latitudinal curl and make the elements across the film, straight lines, without having to support it rigidly across the film. This has a double purpose. It not only allows the light to be focussed directly on an element of the film, but also has a tendency to eliminate the slight curvatures which are present around the perforations of the film.

The sound record is quite close to the perforation of the film, and the curvature, due to the perforation at the edge of the perforation, sometimes extends into the sound record and has a bad effect upon it. However, the curving of the film arcuately in the longitudinal direction eliminates most of these irregularities without having to have a gate pressed upon

the film across it to straighten it out, as would be necessary if the film were allowed to pass through the gate in a straight line. For this reason, if the film is bent around the roller in Figure 2—I am sorry there is not a roller here so that I can illustrate it—it takes a flat position at the point of translation; in other words, the line of light may now be focussed exactly to its minimum dimension, and therefore will illuminate only a very small area of the film.

There is another characteristic of the film as it is bent around in an arcuate direction. If your Honor will notice, if I lay the film on its edge, straightened out, and press on it, that it has little or no resistance to pressure—it will fold very easily. If I curve it and then press on the curved portion you will find that it is very stiff. At the position at which it is curved, it occupies its full width, so that if we have lateral guides to hold the film in position, to center up the sound track with the line of light, these guides will be many times more effective if the film is curved at the point at which the guides work. If we try to run the film through without being curved, the guides may simply crinkle the film and press it together without giving any definite effect to the sound track. The lines may be one-eighth of an inch out of line, or some such figure.

Q. 56. If I may interrupt you at this point, Professor, will you show the Court how close those fine lines constituting sound tracks come to the sprocket holes in the film on that side?

A. I think the Court can see that the record extends almost to the edge of the perforation. The edge of the record is not more than a few thousandths of an inch from the perforation. And the slight curvature around the perforation very frequently extends into the record, preventing an exact focussing of the line of light on the sound record.

Q. 57. Now, on the strip of film you have there, can you show the Court how far out the buckling of the film around the sprocket extends towards where the sound track is located?

Q. 57a. By that I mean the buckling around each individual sprocket hole.

A. That is somewhat difficult to see unless the film is held so that you get reflection from the light. I think the Court perhaps can see that better by taking it in his hand, you notice you get a reflection of these sprocket holes with the light, you can see that they are bent down, around each sprocket hole. The sprocket hole is not punched in the flat surface, but there is a tendency to bend down, due to the emulsion on the other side of the film. The emulsion in this case, your Honor, is on the bottom of the film and not on the top.

Irregularity of surface around the sprocket holes, which is eliminated to a very large degree when the film is flexed in this direction. It straightens out the slight bend around the perforation by flexing of the film, and allows the line of light to be focussed through its entire length down to the one-thousandth of an inch dimension.

Q. 58. That is, when you curve the film arcuately it takes out the other curve in the film around the sprocket hole at the area where the film is curved arcuately?

A. It has that effect, yes.

Q. 59. And you said something about this allowing the proper focussing of the fine lines at that point; that is, if the buckling of the film around the sprocket hole is allowed to remain and you focus your fine light-line down on it, that tends to have the line of light where the buckling around the sprocket hole occurs out of focus with the rest of the area?

A. That is true.

Q. 60. And does that have any effect on the recording of the sound?

A. It has a tendency—it has the effect of muddling the sound record which is recorded on the curved portion near the sprocket.

Q. 61. Is the situation the same, or different, in the case of reproduction?

A. The situation is exactly the same.

Q. 62. Now, you said something about by arcing the film or supporting it on an arc at the point of translation that you were able—as I understood you—to support it without any guides on the film. What is the advantage of that?

A. That allows the film to pass the point of translation without having any hard surface rub on the sound record—which would have a tendency to scratch the sound record.

Q. 63. You do not mean that there is no guide pressing on any part of the film?

A. No.

Q. 64. But that there is none on the emulsion part?

A. There is none pressing on the emulsion part.

Q. 65. That is, "emulsion record" part?

A. Yes, sir.

Q. 66. Now, will you please state the advantages of using the toothed cylinder acting with the perforated film on the shaft where the flywheel is located?

A. The toothed cylinder is necessary for sound motion pictures, because the film moves through the apparatus not at so many feet per minutes but at so many perforations per minute. Of course, it is the aim of film manufacturers to keep the distance between perforations uniform. But on account of aging of the film, the shrinkage of the film and various other factors, it frequently happens that the perforations may be considerably less after a given period of time than

they are when the film was originally manufactured—that is, the distance between perforations.

The reason why the film must be driven at a constant number of perforations per unit of time is on account of the requirements for the picture projection. There are four perforations for each little frame of the picture—as your Honor will see—each picture has at its edge four perforations. And if the rate at which the pictures are shown is of any importance, we must have four of these perforations pass through the machine for each individual frame—as it is called—being projected on the screen.

Now, sometimes when the film has shrunk, the spacing between these perforations is considerably less than it is when the film is fresh. And it is the number of pictures per second that is one of the controlling factors.

Of course, if we had nothing but a smooth roller, a smooth roller would transmit so many feet per minute irrespective of the spacing of the sprocket which would not comply with the requirements of the picture projector.

Q. 67. You mean the picture projector or the sound projector?

A. The number of sprocket holes per minute is a requirement imposed by the picture projector. In this case, in the case of Figure 2, this is automatically taken care of by governing the speed of the toothed sprocket.

Q. 68. In other words, the picture film past the sound head must move along at the same rate of speed per minute as the film through the picture head?

A. Exactly.

Q. 69. Now then, if the sprocket is not on the flywheel shaft driving the film, then you should have a sprocket somewhere in the sound head to drive the film?

A. There must be a sprocket somewhere in the sound head.

Q. 70. Either on the flywheel shaft or elsewhere——

A. Yes.

Q. 71. —as a means for propelling it. Now, what is the benefit of having the driving member of the film in the sound head a different element from the flywheel? That is, in having the sprocket a different element from the flywheel itself, rather than to have the film go over the flywheel?

A. The filtering action of the flywheel filter depends not entirely upon its dimensions or its weight, but rather upon the moment of inertia and the speed of rotation. The film velocities are stabilized—in present-day parlance—at about 90 feet per minute. If the film were led around the outside periphery of this roller, the roller would revolve at a very much slower speed than if it is led around the roller R. If the relation between these two diameters is as two to one, we get twice the speed in the second case compared to that described in the first case.

If we double the speed of rotation of a flywheel, we store four times as much kinetic energy and we have four times the stabilizing effect. Therefore, letting the film pass around a roller which is of smaller diameter than the flywheel, we may increase the effectiveness of the flywheel many, many times without increasing its weight, by merely arranging the flywheel to operate at a higher speed.

Q. 72. Can you state whether or not the importance of supporting the film on a curve or arcuately, whether the advantages of that are peculiar to photographic sound recording on film with a line of light, or whether the advantage of having the film curved that way also attaches to motion picture projection or other means of recording or reproducing sound?

A. There is no particular advantage of arcuately bending the film in motion picture projection, except in connection with the sound reproduction, that I think of for the moment.

There is for other types of sound records, perhaps, such as might be produced by having a stylus with a diaphragm rest on the film; it would be of relatively little importance; because whether or not the film is up or down a thousandth is of little or no importance, because the sound box has a certain amount of flexibility and can follow the weaving of the film up and down.

In the case where sound is recorded by moving a fine spot of light back and forth across the film, the question of focussing no longer comes into account, because the width of the motion is so extremely small that it does not become out of focus.

Q. 73. Now will you please take the defendants' structure, PS1, and point out in that structure its operations with respect to the features of the patent in suit. In doing so, Professor, you had better trace the whole movement of the film and describe sufficient of the mechanism to the Court to have him understand it.

A. Exhibit 16-C shows a schematic view of the passage of the film through the entire apparatus. And I refer to it briefly at this point, because it shows that the film passes down through the intermittent motion of the picture projector, which is represented in this case by the parts correspondingly labelled. I find one sprocket here labelled as "intermittently rotating sprocket of the picture projector," and below that a "continuously driven sprocket."

The film does not, as it passes the intermittent rotating sprocket of the picture projector, the film does not move uniformly, but moves by jumps. The picture is allowed to stand still at the picture gate for a short period of time while it is projected on the

screen, and then it is very quickly moved out of line, so that the next picture may be projected.

That is accomplished by means of the intermittent action of the sprocket so labelled.

It then passes down into the so-called sound head, passes from one point at which it enters the sound head to another point from which it leaves the sound head.

Q. 74. One minute. Wouldn't it be better to use the little chart, Professor, so the Court can see it?

A. All right. I am now referring to Chart Exhibit 16-A, on which many of the elements are similarly labelled; that is, they are labelled in the same terms as those on 16-C.

The film passing into the sound head passes the area of translation at which it is curved and at which point the fine focussed line of light is allowed to impinge on the film—directly to the sprocket shaft—which is connected rigidly to the flywheel, which, in this particular chart is shown and indicated as being blocked out in red. After having been moved past the area of translation by the flywheel shaft, under the control of the uniform motion of the rotating flywheel, it passes over a loop finally past the takeup sprocket into the takeup reel, where the film is wound up.

Q. 75. Now, will you state next how the flywheel and the sprocket entitled "sprocket cylinder," the cylinder on the flywheel shaft, how they are connected and also how that shaft is driven.

A. The uniformly rotating sprocket cylinder is connected to the same shaft with the flywheel.

Q. 76. You might refer to Figure 8, I think.

A. It happens that the sprocket is on one side of a wall—referring to Figure 8—and the flywheel is located behind this wall, for mechanical purposes. The flywheel in this case is driven through a spring which, in these charts, is shown as colored blue. In this case

it resembles somewhat an alarm clock spring and is somewhat of the same size. It is driven through this spring by a gear wheel L, from the source of driving power of the system and allows, through the relative motion of the flywheel and the driving mechanism, the flywheel to absorb—the filter flywheel—to absorb any irregularities of the driving motion that may be produced up to this point from any cause.

Q. 77. I would like you to go a little more in detail on that. You said the shaft entitled "flywheel shaft" is driven from the source of power. What is the element here that does drive that, applies the power?

A. That is a gear, spur gear.

Q. 78. J?

A. "J."

Q. 79. And that drives what?

A. That drives the inside ends of the spring. The outside ends of the spiral spring being connected rigidly to the flywheel.

Q. 80. And what is the element marked L?

A. L is a device which co-operates with the stop pins to prevent the spring from winding or unwinding to an undue extent.

Q. 81. That is, the stop pins are on the flywheel?

A. The stop pins are on the flywheel and this irregular shaped cam L co-operates with the spring to react against the stop pins and limit the motion of the spring.

Q. 82. Not allowing the spring to have too much of the rotation movement with respect to the flywheel?

A. That is quite true.

Q. 83. Then the sprocket J is loosely mounted on the flywheel shaft and, through the spring and the stops, drives the flywheel, which in turn is keyed to the flywheel shaft?

A. Yes. This is indicated on Figure 8, where it can be seen that the sprocket on the flywheel shaft has a pin driven through it to rigidly connect it to the flywheel shaft. The flywheel has a semi-circular key to rigidly connect it to the flywheel shaft; whereas, the gear J revolves around the flywheel shaft and is not rigidly connected to it.

Q. 84. Now, in that construction is there any intermediate gearing between the flywheel and the sprocket on the flywheel shaft which drives the film, which intermediate gearing would set up irregularities?

A. Yes, there are many such elements. It is not very easily seen.

Q. 85. I think you misunderstood my question. I said between the flywheel and the sprocket.

THE WITNESS: Will you read the last question—the one ahead of it.

(Question read as follows: "Q. Now, in that construction is there any intermediate gearing between the flywheel and the sprocket on the flywheel shaft which drives the film, which intermediate gearing would set up irregularities?")

A. There is no such intermediate gearing or other systems which could produce irregularities, because the flywheel is rigidly connected to the same shaft that carries the sprocket.

Q. 86. Now, will you please point out the manner in which the film is supported at the translation point, on PS1, for instance?

A. The film is yieldably supported adjacent to the translation point by these two springs which are labeled "tension springs," on Exhibit 16-A, and at which point these springs tend to hold the film into contact in an arcuate longitudinal relation. These springs do not rest directly on the sound track, but are arranged

so that they do not scratch the sound track as the film passes the translation point.

Q. 87. Will you point to a figure on one of the charts where the springs are shown pressing outside of the record area?

A. The tension springs are shown in more detail in Figure 5 of Exhibit 16-B. They are labeled here as such on the chart and are shown in an unflexed position, since the gate has been removed from contact with the film. Under normal conditions they would be flexed to cooperate with the curvature of the gate.

Q. 88. Is there any cooperation between the holding of the film on the arced surface by the spring at the translation point and the flywheel, in the movement of that film and, if so, what is it?

A. Yes. There most certainly is. Any slight—referring now to Figure 1 of Exhibit 16-A—any slight mechanical flutter of the film as it engages with the teeth of the uniformly rotating sprocket cylinder would be prevented from reaching the translation point by the action of the tension springs—as it can be seen from this chart.

A mechanical vibration or wave would be damped out by the action of the tension springs.

And secondly, the tension springs in exerting a mild amount of tension on the film from the point at which they contact to the film, to the sprocket shaft, bring out the elastic properties of the film in this position and further absorb any slight irregularities of speed due to tooth engagement at the point of engagement with the sprocket cylinder.

The film, it must be understood, has a certain amount of longitudinal elasticity, and there is a tendency for slight vibrations to be absorbed in a tensed section.

Q. 89. Will you state whether or not the flywheel as shown in that construction PS1 imparts uniformity

of motion to the film as it passes past the translation point?

A. It does. The action being adjacent to the area of translation and its motion uniform, it imparts a uniform motion to the film as it passes the area of translation.

Q. 90. And in that structure does the defendant use an optical slit for focussing the light onto the film?

A. The defendant uses what is generally known as an optical slit for focussing the light on the film—which corresponds to the system shown in the patent in suit.

Q. 91. And is it focussed down to a coarse line or a fine line?

A. It is focussed, with the proper adjustment the line is focussed to an extremely fine line at the point where it impinges upon the film.

Q. 92. Now, Professor, does that defendants' structure contain a photoelectric cell?

A. It does.

Q. 93. Will you point out where that is?

A. That is shown on Figure 1 of Exhibit 16-A. It is to the extreme right, about half way up the exhibit, and so labeled.

Q. 94. Is the flywheel for controlling the uniform movement of the film through the PS1 structure, illustrated in all views in red?

A. It is.

Q. 95. Now, I note there is another "flywheel" in Figure 7 of that defendants' structure. Will you tell what that is?

A. This flywheel has a distinctly different function. It is located, as can be seen, in line with the intermittently rotating sprocket of the picture projector. And serves to carry over the dead center, as it were, due to the pull of the intermittent rotating sprocket at the instant the picture is pulled down. The drive on the shaft is not a constant drive, but it is called upon

at periodic intervals to give the film a quick pull down, and then there is no power required on the shaft until the next picture has to be pulled down in place.

Q. 96. Would a flywheel on the motion picture movement of the sound picture machine produce uniform movement at the sound head at the point of translation if there is no other flywheel, that is, if this flywheel here is the only flywheel; would that operate to give a uniform movement of the film at the translation point of the sound?

A. No, because this flywheel does not revolve at a uniform speed. Its characteristic is that it slows up to a very slight degree each time the load due to moving the picture is impressed upon it. This flywheel is not revolving at a uniform speed because it has a pulsating load impressed upon it, and any irregularity of motion such as that which is very, very common in spur gearing which would be transmitted in addition to its non-uniformity of speed down through the spur gear system to the film sprocket.

Q. 97. The defendants' machine, in addition to having the ordinary flywheel, has the sound head flywheel?

A. Yes.

Q. 98. What is that sound head flywheel usually referred to in the art as?

A. As the filter flywheel.

Q. 99. Will you just state to the Court briefly the significance of that term?

A. It filters out from the motion of the film, slight irregularities due to a number of different causes. Irregularities due to the drive of the spur gears, due to the varying pull produced by the intermittent shaft, and perhaps other irregularities in the driving mechanism. This is driven by a chain. A chain does not produce absolute constant transferral of motion. There are many sources of irregularities in the system

which are eliminated by this flywheel located directly at the driving point of the film.

Q. 100. Professor, I will ask you to apply the claims relied upon here, first, to one or more views of the patent drawing and, after having done that, I will ask you to apply them to the PS1 structure.

A. Do you want me to start with Claim 5?

Q. 101. Yes, please start with Claim 5.

A. The figures of Claim 5 are illustrated in Figures 1, 3 and 5. The claim reads:

> "In phonographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass, having feeding perforations therein, the combination of means for supporting and progressing the record ribbon from one point to another point . . ."

Referring now to Figure 1, the one point is the point at which the film enters the sound apparatus, and the other point is that at which the film leaves the sound apparatus. It is not shown very well on Figures 3, 4, 5 and 6, because only a small section of the film is shown. However, somewhere in the neighborhood of f and f (two f's on Figure 4) would be the point at which the film enters and leaves the apparatus.

Q. 102. Those are the points where you read from the specification, where the loops would be formed?

A. Yes. As I briefly pointed out, the specification provides for a loop to be formed here, and another pair of rollers, not shown, to guide the film. (Reading):

> ". . . to another point and past an intermediate point at which the record is made on the ribbon in recording or from the record is taken from the ribbon in reproducing . . ."

Figure 1 shows this intermediate point as the point at which the light is focussed on to the film. It is very near this point marked f but slightly above it, however. The intermediate point in Figure 3 is indicated as t. Figure 4 has the same designation of t, and Figure 6 is also represented by t.

Q. 103. I think it might be helpful to refer to those translation points as where the yellow light lines pass.

A. Yes. In each case they may be defined as where the yellow lines cross the film. (Reading):

> ". . . including a toothed cylinder . . ."

The toothed cylinder in Figure 1 is marked $r_2$; in Figure 3 it is marked d; in Figure 4 it is d, and likewise in Figure 6. (Reading):

> ". . . over a portion of which the ribbon passes adjacent to said intermediate point . . ."

It will be noted that in Figure 1 the intermediate point is located adjacent to the position where the ribbon is passing over the toothed cylinder. The same is true in Figure 4. Here the translation point denoted by t is immediately adjacent to the contact between the film and the toothed cylinder and, although it cannot be seen quite so clearly in Figure 6, yet the effect is much the same as in Figure 4. (Reading):

> ". . . The teeth of said cylinder engaging the perforations of the ribbon . . ."

I think that is evident from the inspection of these figures. (Reading):

> "A flywheel associated with said cylinder . . ."

Figures 1 shows the flywheel $m_2$ associated with the toothed drum $r_2$. Figure 3 shows the flywheel "I"

associated with the toothed drum d and the same is true in Figure 6.

(Reading): ". . . and means for rotating said cylinder, under control of said flywheel at uniform speed." The specifications state that this structure may be directly connected to the driving motor through suitable interconnections to drive the flywheel and progress the film. In the case of Figure 3, the gear h' being rigidly connected to the same shaft which carries the flywheel, and the sprocket d serves as the means for driving the flywheel. In Figures 5 and 6 the flywheel is driven through an elastic coupling consisting of the spring 3 co-operating with the arm 2 in Figures 5 and 6, which in turn are driven by the gears h' on the right-hand side of the shaft in Figure 6.

Q. 104. In the structures are the cylinders rotated under control of the flywheel at uniform speed?

A. Yes. They are rigidly connected to the flywheel, and the uniform speed of the flywheel is therefore directly transferred to the cylinder.

Q. 105. Will you refer now to Claim 7 and read that on some of the drawings?

A. Claim 7 reads:

> "In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another . . ."

These two points in this claim are exactly the same as the points referred to in the previous claim. I won't take the time to point them out.

(Reading): ". . . and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing . . ."

Claim 7 reads, on Figures 5 and 6, and this translation point is indicated on Figure 6 by the letter t and is shown as the point at which the yellow line bundle of rays cross the film f.

(Reading): ". . . including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point . . ."

The cylinder is here shown as d, and the carrier passing over a portion of the cylinder adjacent to the intermediate point, in this case the intermediate point is indicated by t.

(Reading): ". . . a flywheel . . ."

The flywheel is indicated by i' in Figure 6.

(Reading): ". . . a shaft on which said cylinder and flywheel are both secured . . ."

This is indicated by, I think it is 7. I am not quite sure.

Q. 106. It is 1, I think.

A. I will call it 1, then.

(Reading): ". . . a driving member coaxial with said shaft . . ."

The driving member being the arm 2 in conjunction with the gear h'.

(Reading): ". . . a resilient connection between said driving member and flywheel . . ."

The resilient connection is here shown as the spring 3, colored blue.

(Reading): ". . . and stop means for limiting the amount of yielding of said resilient connection."

The stop means are shown in Figure 5 and are lettered 5.

Q. 107. Now, will you refer to Claim 9, please, and read that as the next claim in order. Read that on the drawings to which it applies.

A. Claim 9 reads:

> "The method of translating sound or similar vibrations to or from a film record . . ."

As shown in Figures 2, 3 and 6, the film record is indicated here as f in Figure 2, the f in Figure 3, and f on Figure 6.

(Reading): ". . . by the use of light varied in accordance with the sound . . ."

In reproduction the light which passes through the film will be varied in accordance with sound due to the action of the moving film. As is here shown in Figure 2, light passing through the film at the translation point. A similar condition is shown in Figure 3, light varied with sound passes through the film at the point t and impinges upon the photoelectric cell z, as has already been shown in Figure 6.

(Reading): ". . . which comprises flexing the film arcuately longitudinally . . ."

The film is here flexed in Figure 2 arcuately longitudinally around the upper part of the roller R. The same is true in Figure 3, the roller in this case being d, and in Figure 6 the roller being also d.

(Reading): ". . . at the point of translation . . ."

It will be noticed that in these three figures the translation point is at a position where the film is arcuately flexed.

(Reading): ". . . and rapidly and uniformly moving the film in a circumferential direction past said point."

In Figure 2 the motion of the flywheel m transmitted to the roller R moves the film rapidly and circumferentially past the translation point as indicated on the figure. And this is also true in Figure 3 and in Figure 6.

Q. 108. Now, will you read the disclaimer of that claim?

A. (Reading): ". . . wherein the uniformity of movement of the film past the translation point is effected by subjecting the portion of the film passing

said point to the control of the inertia of a rotating weighty mass."

The rotating weighty masses which control the motion of the film are shown as m in Figure 2, and as i in Figure 3, and i' in Figure 6.

Q. 109. And is the movement of the portion of the film past the translation point subjected to the control of the inertia of the rotating mass?

A. It is, in all three cases.

Q. 110. Will you go on to Claim 13?

A. Claim 13:

(Reading): "An apparatus for reproducing speech, music or the like sound from vibrations recorded on a film, by the use of a line of light varied in accordance with the sound . . ."

It is to be understood that a slightly different effect takes place in recording and in reproducing and, inasmuch as this suit is dealing with the reproducing apparatus, I will not take up the case of recording unless it is desired. The light varied in accordance with the sound is the light which passes through the film and is varied by the variable blackening of the film, and is shown in each of these figures—I think this claim applies to all of the figures—as the light which passes through the translation point and impinges on the photoelectric cell.

(Reading): " . . comprising a photoelectric cell . . . "

In Figure 1, the cell is shown as z——

Q. 111. One minute, Professor. I think it will save time. You have said the claim reads, on all of the figures, so please apply it to one, unless Mr. Neave wishes to apply it to all.

Mr. Neave: I haven't any choice.

A. (Reading): " . . . comprising a photoelectric cell . . . "

Taking Figure 2 for simplicity, the photoelectric cell is indicated as z.

(Reading): " . . . means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell . . . "

In this case the film is progressed by the combined action of the sprockets V and V2. And uniformity of motion is assured by the flywheel effect of the mass m acting upon the smooth roller R.

(Reading): " . . . a source of light projection for providing said light . . . ."

This is indicated at o.

(Reading): " . . . and an objective lens in the path of said light and spaced from the film . . . "

The objective lens is located at the lower end of the cylinder indicated by o.

(Reading): " . . . and spaced from the film . . . "

The objective lens in this case—there is a free space between the position of the objective lens and the film, which can be seen.

(Reading): " . . . for directing said light as a converging narrow line impinging on the film at a point in the region of the focal point of said lens . . . "

That is shown and described in the specification, shown on the diagram by the convergence of these lines indicating the rays of light. These rays focus at the surface of the film.

(Reading): " . . . said light passing through the film and on to said cell . . . ."

Light from the point of translation passes through the film and on to the cell z.

(Reading): " . . . the space between said lens and the film being free of obstructions to said light."

I think that is aptly illustrated in Figure 2.

(Reading): ". . . wherein a flywheel is operatively connected with the film through means which imparts uniformity of motion of the flywheel to the film."

The roller r and the pressure rollers $dr_1$ and $dr_2$ serve to connect the flywheel with the film in such a manner as to impart uniformity of motion of the flywheel to the moving film.

Q. 112. Before you go to Claim 17, I think you said the source of light was indicated at o. You said the objective was o.

A. The specifications, I believe, describe the objective o, which would indicate that it is inside of the cylinder.

Q. 113. The source of light behind the objective is not shown?

A. The source of light in this case is not shown.

Q. 114. Now, will you take up Claim 17.

A. (Reading): "In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing . . . "

This has been applied exactly the same as in the other claims.

(Reading): " . . . including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point . . . "

Applying this to Figure 2, the cylinder is lettered R, the carrier passes over a portion of the periphery of this cylinder, and it is immediately adjacent to the point of translation.

(Reading): " . . . a flywheel operatively associated with said cylinder . . . "

The flywheel m is connected directly to the cylinder R.

(Reading): " . . . said carrier progressing means operating to advance the carrier past said inter-

mediate point at uniform speed under the control of said flywheel."

The progressing means in this case being the combined action of the two sprockets progresses the film past the intermediate point under the control of the inertia of the flywheel, since the film is resting on the periphery of the smooth roller R, which is directly connected to the flywheel.

Q. 115. Will you read the disclaimer in connection with that claim?

A. (Reading): " . . . wherein a sprocket engaging the carrier forms a part of the carrier progressing means and a substantial portion of the periphery of the cylinder is in contact with the carrier . . . "

This being the portion of the periphery of the cylinder between the point at which the film contacts to the right and the intermediate point at the top of the cylinder.

> " . . . is in contact with the carrier in its travel from the intermediate point to said sprocket."

The intermediate point being illustrated by the yellow rays of light, and the sprocket referred to being V2.

> MR. NEAVE: The witness has read that claim only on Figure 2. I would be very glad if he would state on what other figures in the patent it reads also.
>
> THE WITNESS: I purposely do not apply it to other figures, just to save time.
>
> MR. NEAVE: Don't apply it. Just tell me what other figures.
>
> THE WITNESS: Without considering it in detail, I for the moment believe that it only applies to

Figure 2. I may be mistaken on that. That is not the result of mature thought.

Q. 116. Will you apply Claim 18 now.

A. (Reading): "The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising rapidly advancing the film past the point of translation, and subject the motion of the film in passing said point, to the control of inertia means to effectively eliminate irregularities in the movement of the film."

This can be applied to almost any of the figures. I will take Figure 2 for convenience. Rapidly advancing the film past the point of translation: the point of translation is shown as the convergence of the yellow lines on the chart Figure 2——

(Reading): " . . . subjecting the motion of the film in passing said point, to the control of inertia means . . . "

Inertia means are indicated as the flywheel m and they control the motion of the film through the action of the coupled roller R.

(Reading): " . . . to effectively eliminate irregularities in the movement of the film."

As will be seen the inertia of the flywheel has a tendency to eliminate many irregularities.

(Reading): " . . . wherein the inertia control is effected by passing the film over a rotating member . . . "

The rotating member in this case is R.

> " . . . and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

This last is the function of the filter flywheel m.

Q. 117. Now, will you please take up the last

Claim, 19, and since that is an appendage to Claim 18 with additional steps in it, in the method, just start with where that starts.

A. (Reading): " . . . in which the film is yieldingly pressed into contact with a supporting area immediately adjacent the point of translation . . . "

Reading this on Figure 2 again: the film is yieldingly pressed into contact with the supporting area, the supporting area in this case being the upper half of the roller R which is immediately adjacent to the point of translation, such action of being yieldingly pressed being performed by the spring-pressed rollers $dr_1$ and $dr_2$.

(Reading): " . . . such pressure co-operating with the inertia control in the elimination of irregularities in the film motion."

As has been previously pointed out, the flexibility of the portion of the film between the sprockets V and V2 as enhanced by the spring-pressed rollers, is capable of absorbing many irregularities.

(Reading): " . . . wherein the inertia control is effected by passing the film over a rotating member. . . "

(Reading): " . . . and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

The inertia being applied by the filter flywheel m.

Q. 118. In reading the claims, I do not think that you in each case referred to the general disclaimer to the patent that the sound is translated by light to or from a film strip moving uniformly past said light. That limitation would not in any way affect your reading of the claim on any of those structures, would it?

A. It does not, because each of the structures illustrates a light record, photographic record.

Q. 119. Now will you please apply Claim 5 to the PS-1 structure?

A. (Reading): "In photographic apparatus in which the sound record is formed on an elongated ribbon of inconsiderable mass." Such ribbon being marked as "Film" on Figure 1 of Exhibit 16-A, Figure 2 of Exhibit 16-B, and Figure 6 of Exhibit 16-C.

Q. 120. I think, Professor, to save time you need only refer to any one of the three figures of the structure PS-1, where your element may be found, the one that is most easily detected by the Court.

A. (Reading): "Means for having feeding perforations therein." These feeding perforations are not shown, but since the ribbon contacts with toothed sprockets, they are indicated.

(Reading): "The combination of means for supporting and progressing the record ribbon from one point to another point and past an intermediate point." "One point to another point" being the point at which the film enters the sound head and the point at which the film leaves the sound head; and the "intermediate point" being the area of translation, which is so marked on Figure 1.

(Reading): "Past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing." In this particular case, the machine is a reproducing machine.

Q. 121. And where is that intermediate point?

A. The intermediate point is marked here as the "Area of Translation" and is shown as the point at which the light is focussed on the film.

(Reading): "Including a toothed cylinder": The toothed cylinder referred to is marked "Uniformly Rotating Sprocket Cylinder."

Q. 122. On the flywheel shaft there?

A. On the flywheel shaft.

(Reading): "Over a portion of which the ribbon passes adjacent to said intermediate point": The film

passes around a portion of the periphery of the uniformly rotating sprocket cylinder, being located adjacent to the point marked "Area of Translation," which in this case corresponds to the "intermediate point" of the claim.

(Reading): "The teeth of said cylinder engaging the perforations of the ribbon": This is shown in Figure 1, where the teeth of the uniformly rotating sprocket cylinder engage the perforations of the ribbon.

(Reading): "A flywheel associated with said cylinder": The flywheel is shown in Figure 1 and in Figure 8, as being rigidly connected to the same shaft to which the sprocket,—uniformly rotating sprocket cylinder is pinned, and moving in exact conformity with this sprocket.

Q. 123. Cylinder, sprocket cylinder?

A. Cylinder.

(Reading): "And means for rotating said cylinder, under control of said flywheel at uniform speed": The means for rotating the cylinder comprise the shaft connecting the cylinder with the flywheel and which forces the rotation of the sprocket on the flywheel shaft to be at exactly the same rate as that of the flywheel itself, as they are rigidly connected together.

The flywheel is driven—"Means for rotating the flywheel" of course embody a spring and the driving mechanism—the driving gear J, which imparts motion to the flywheel.

Q. 124. Professor, are these the regular sizes and and dimensions of the defendants' machines, or what are they, enlarged or reduced?

A. Figure 1 is somewhat enlarged. Figure 2 is enlarged, but to a lesser degree than Figure 1.

Q. 125. Now will you go ahead on the Claim 7?

A. Claim 7. Shall I read the preliminary portion of that claim, since it is——

Q. 126. I think you might skip the preliminary portion of the claim.

A. Skipping the preliminary portion of the claim. (Reading): "Including a cylinder . . . "

Q. 127. You better read it, read the whole of it.

A. All right. (Reading): "In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier in recording or from which the record is taken from the carrier in reproducing, including a cylinder over the portion . . . "

Q. 128. Just one minute. That part of the claim down to "including the cylinder" you already pointed out.

A. I have already taken care of in connection with Claim 5. (Reading):

> "Including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point,"

The cylinder—referring to Figure 1—is labeled as the "Uniformly Rotating Sprocket Cylinder", and the carrier passes over a portion of the periphery.

(Reading): It is "adjacent to said intermediate point,": The intermediate point being the point "Area of Translation," as indicated on Figure 1.

(Reading): "A flywheel,": The flywheel is shown on Figure 1, and so labeled, and is also shown on Figure 8.

(Reading): "A shaft on which said cylinder and flywheel are both secured,": In Figure 1, this is labeled "Flywheel Shaft." It is shown to better advantage in Figure 8, although not so marked.

The flywheel is connected with a semicircular key to the shaft, and the sprocket is connected to the shaft by means of a pin.

(Reading): "A driving member coaxial with said shaft,": The driving member in this case, referring to Figure 8, is the gear J.

(Reading): "A resilient connection between said driving member and flywheel,": In this case, it is the spring—I don't see the reference character to the spring here; there is no reference character on it.

Q. 129. Colored blue?

A. But it is colored blue and indicated by the legend.

(Reading): "And stop means for limiting the amount of yielding of said resilient connection." "Stop means" in this case is the cam M co-operating with the stop pin of Figure 8.

Q. 130. And the corresponding pin in cam surface on the other.

A. Yes, there are two pins shown. The stop pin I should have said. One limiting the motion in one direction and the other limiting it in the other.

Q. 131. That is, limiting the amount of yielding of the spring?

A. Yes, that is correct.

Q. 132. Now will you proceed with Claim 9?

A. (Reading): "The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound,": The apparatus of PS-1 of course utilizes this principle.

(Reading): "—which comprises flexing the film arcuately longitudinally at the point of translation": This is illustrated in Figure 1, where it can be seen that the film is flexed arcuately longitudinally at the point of translation; this being indicated on the Chart Exhibit 16-A by the legend "Area of Translation."

(Reading): "and rapidly and uniformly moving the film in a circumferential direction past said point." The uniformly rotating sprocket cylinder pulls the film down at a uniform speed and moves it in a circumferential direction past the point of translation.

(Reading): "Wherein the uniformity of movement of the film past the translation point is effected by subjecting the portion of the film passing said point to the control of the inertia of a rotating weighty mass": In this case, the rotating weighty mass is indicated as the flywheel, which is rigidly attached to the same shaft that carries the uniformly rotating sprocket cylinder.

Q. 133. Will you proceed with Claim 13?

A. Claim 13. (Reading): "An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, by the use of a line of light varied in accordance with the sound,": The line of light is indicated on Figure 1 at the position marked "Area of Translation"; and it is varied in accordance with the sound by passing through the variable transmission sound record and being allowed to fall eventually on the photoelectric cell.

(Reading): "comprising a photoelectric cell,": The photoelectric cell is located to the extreme right of Figure 1, Exhibit 16-A, and so labelled.

(Reading): "means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell,":

The uniformly rotating sprocket cylinder produces the motion of the film past said cell.

(Reading): ". . . a source of light projection for providing said light, and an objective lens, . . ."

The source of light projection for providing said light is shown as the combination of the exciter lamp co-operating with the slit.

(Reading): ". . . and an objective lense. . . ."

The objective lens is located spaced apart from the area of translation and so labelled on the diagram.

(Reading): ". . . the objective lens in the path of said light and spaced from the film for directing said light as a converging narrow line impinging on the film at a point in the region of the focal point of said lens, . . ."

I think this relation is aptly illustrated in the drawing, the combination of the two lenses, focus the image of a line of the slit on the film at the area of translation. The lines of light as they pass onto the film are obviously converging.

(Reading): ". . . said light passing through the film and on to said cell, the space between said lens and the film being free of obstructions to said light."

There is a free space between the objective lens and the film which does not admit of obstruction to the light.

(Reading): ". . . wherein a flywheel is operatively connected with the film through means which imparts uniformity of motion of the flywheel to the film."

This has already been discussed in connection with the Figure 8, showing the rigid connection of the flywheel on the same shaft as that which carries the sprocket and hence imparting the uniform motion of the flywheel to the sprocket.

Q. 134. And will you next take up Claim 18.

A. You want to omit 17. Claim 18:

(Reading): "The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, . . ."

This being the action involved in the reproducing action involved in defendants' apparatus.

(Reading): ". . . comprising rapidly advancing the film past the point of translation, . . ."

The point of translation is indicated on Figure 1 as the area of translation, being the point at which the light beams converge on the film.

(Reading): "and subjecting the motion of the film in passing said point, to the control of inertia means to effectively eliminate irregularities in the movement of the film."

The film being drawn down by contact with the sprocket teeth on the uniformly rotating sprocket cylinder, which is in turn directly connected with the flywheel, form the means for subjecting the motion of the film in passing said point to the control of inertia means to effectively eliminate irregularities in the movement of the film.

And further: (Reading) ". . . wherein the inertia control is effected by passing the film over a rotating member and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

The combination of the toothed sprocket rigidly connected to the flywheel and other contributing elements that have been previously discussed, act to eliminate the irregularities in the motion of the film.

Q. 135. Will you please proceed to apply Claim 19. You may start that claim as you did before, just where the claim starts, and says "The method according to Claim 18, and in which the film is yieldingly," and so forth. Just go on from that point.

A. (Reading): ". . . the film is yieldingly pressed into contact with a supporting area immediately adjacent the point of translation, . . . "

The action of the tension springs illustrated in Figure 1 is yieldingly pressing the film into contact with a supporting area immediately adjacent the point of translation. The supporting area here is not so labelled.

Q. 136. Take it on one of the other drawings where you can show it.

A. The supporting area is shown in more detail in Figure 4 of Exhibit 16-B, and is marked A. The tension springs in Figure 5 yieldingly press the film against the supporting area marked A in Figure 4, and this, as can be seen by reference to Figure 1, is adjacent the point of translation.

Q. 137. Is it immediately adjacent?

A. It is immediately adjacent the point of translation in this case.

(Reading): ". . . such pressure co-operating with the inertia control in the elimination of irregularities in the film motion."

As has been already pointed out, any fluctuations due to engagement of the teeth at the uniformly rotating cylinder will be prevented from affecting the motion of the film at the point of translation by the pressure of this yieldingly pressed spring. The spring has another function in that it exerts a tension on the strip of film between the uniformly rotating sprocket cylinder and the point of contact of the spring, and enables some of the elasticity of the elastic effect of the film to take up certain of the irregularities in the motion.

(Reading): ". . . wherein the inertia control is effected by passing the film over a rotating member . . ."

The rotating member in this case being the uniform rotating sprocket cylinder on Figure 1.

(Reading): ". . . and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

The flywheel is directly connected to the same shaft that carries the uniformly rotating sprocket cylinder, and hence applies its inertia effect to the motion of the cylinder.

Q. 138. Will you please take the charts showing the defendants' other structure, PS16, and explain the structure and operation to the Court before you apply the claims to it?

A. Referring to Figure 1 of Exhibit 15-D, the film is fed from the intermittent movement of the picture projector, past a continuously driven sprocket, past the area of translation, at which point it is traversed by the projected line of light which passes through on to the photoelectric cell, then over a portion of the periphery of a uniformly rotating smooth cylinder which is directly connected to the flywheel, past a toothed continuously driven sprocket, down through the takeup sprocket, and out on to the takeup reel.

Q. 139. In this PS16 structure, will you please point out how the film is supported at the translation point?

A. It is supported in this case much as in the case of PS1, by the action of the tension spring pressing against the extreme edges of the film as it passes over an arcuately curved supporting area immediately adjacent to the point of translation.

Q. 140. And in this case, as in PS1, is the light focussed down to a fine line transverse of the film?

A. The optical system is very much the same as PS1, and focusses the line of light at the surface of the film to one of very narrow dimension.

Q. 141. And do you find the photoelectric cell present in this structure?

A. The photoelectric cell is located in the relatively same position and has the same function in this structure.

Q. 142. Will you refer to the drawings of the PS16 and explain the connection of the flywheel to the smooth cylinder over which the film passes?

A. The flywheel is directly connected, as can be seen on Figure 8′, the flywheel is directly connected on

the same shaft that rigidly carries the uniformly rotating smooth cylinder, both connections being rigid connections.

Q. 143. Is there anything in the way of gearing or mechanical connections driving the flywheel or the smooth cylinder in this structure, other than the film itself?

A. There is no drive provided for the flywheel or uniformly rotating smooth cylinder in this structure, except that which is due to the film itself.

Q. 144. In this structure, have they got a different or the same motion picture structure on the machine that you described as PS1? Have you compared them in the two cases to see whether they are different or not?

A. In the two machines which I inspected, the motion picture equipment was identical. The sound head was merely changed, using the same motion picture equipment. There was a difference in the way in which the motor was connected up to the apparatus. In the one case a belt was shown us. I understood later that a chain should have been shown; and in PS16 the motor is apparently geared to the projector.

Q. 145. Except for whatever differences there are in the application of the motor to the machine as a whole, the rest of the motion picture structure is substantially the same?

A. As I remember it, it is substantially the same.

Q. 146. And in this structure does the flywheel act as the intermittent sprocket as it did in PS1?

A. It does. This flywheel revolving at approximately four times the speed of the filter flywheel, operates four times as many revolutions per minute as that of the filter flywheel.

Q. 147. And the flywheel in PS16 is indicated by the word "flywheel" in the upper right-hand corner of Figure 7'?

A. That is true.

Q. 148. In this machine, as in PS1, in your opinion, would the flywheel shown on the moving picture part of the machine effect uniform movement of the film in the sound head?

A. It would not.

Q. 149. It could not, for the same general reasons that you gave with regard to the PS1 structure?

A. Yes.

Q. 150. I would like you to point out in this structure where is the mechanical slit, the image of which is focussed down to what we call the optical slit.

A. This is indicated on Figure 1′ of Exhibit 15-D above and to the left of the area colored red, indicating the flywheel. It is so labelled as "slit," and an image of this illuminated slit is projected in reduced size upon the surface of the film.

Q. 151. And in Figure 3′, what is shown there at the part marked "tension springs"?

A. Figure 3′ shows a horizontal section taken at approximately the position marked "area of translation" on Figure 1′ of Exhibit 15-D, and it shows that the line of light has a greater length than thickness indicated as the narrow line of light passing through the sound track, and in Figure 3′ we are looking at the long dimension of the line of light, rather than the smaller dimension.

Q. 152. That is, the width of the yellow beam of light in Figure 3, indicates at that scale the length of the fine slit as it is photographed on to the film in recording, or it indicates the length of the line which passes on to the film in reproducing?

A. That is true. Approximately one-tenth of an inch.

Q. 153. And does Figure 3 indicate the tension springs supporting the film on the arched surface outside of the sound record?

A. They do.

Q. 154. Now, I think I neglected, with respect to PS1, to ask you to point out where the physical slit there was.

A. The physical slit of the PS1 apparatus is shown on Exhibit 16-A, slightly above and to the right of the red-colored circle marked "flywheel." It is labelled "slit," and the image of this slit is reduced in size and projected on to the film at the area of translation.

Q. 155. The arrangement is substantially the same as in PS16 which you explained?

A. Yes. Much the same. I see there is an additional lens in PS1. Otherwise much the same.

Q. 156. Now, will you explain how the sprocket marked "continuously driven sprocket," shown on the right-hand side of the red flywheel of Figure 1 of the chart of PS16, is driven?

A. It is rigidly geared through a system of gears to the driving motor, as can be seen in Figure 7′. I cannot tell definitely how many pairs of gears there are. There are several sets of gears between the motor and the continuously driven sprocket.

Q. 157. Will you describe the effect, if any, of the flywheel, smooth roller, and the tension springs in their effect on the sprocket holes, passing over the sprocket teeth in that roller marked "continuously driven sprocket."

A. Since the uniformly rotating smooth cylinder is between the continuously driven sprocket and the point of translation, the irregularities of film motion induced by irregularities of teeth engagement on the continuously driven sprocket are prevented from reaching the film as it passes the area of translation or the point of translation. This is done by co-operation of the tension springs which prevent lateral fluttering of the film from reaching the area of translation,

and the action of the smooth roller on the flywheel shaft which enables the inertia of the flywheel to smooth out other irregularities.

Q. 158. What effect, if any, has the tension of these springs got to do with the contact of the film on the smooth roller?

A. It presses the film into engagement due to the tension which is provided by these springs, and the film is pressed into engagement with the periphery of the smooth roller.

Q. 159. Will you please apply such of the claims of the patent to that structure as are set up? I think the claims there are Claims 9, 13, 17, 18 and 19.

A. Claim 9:

(Reading): "The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound . . ."

In this case the apparatus in question is reproducing apparatus, and the light varied in accordance with the sound is that which passes through the film and reaches the photoelectric cell, as shown in Figure 1.

(Reading): ". . . which comprises flexing the film arcuately longitudinally at the point of translation . . ."

Referring to Figure 1, the film is flexed arcuately longitudinally immediately adjacent to the point of translation by the action of the curved surface and the tension springs which hold the film into contact with the arcuately curved surface.

(Reading): ". . . and rapidly and uniformly moving the film in a circumferential direction past said point."

The continuously driven sprocket, through this toothed engagement with the perforations in the film, moves the film down past the point of translation in a uniform circumferential direction, past said point, and

the uniformity of motion is imparted to it by the action of the smooth roller, and the coupled flywheel in conjunction with the action of the tension springs.

(Reading): ". . . wherein the uniformity of movement of the film past the translation point is effected by subjecting the portion of the film passing said point to the control of the inertia of a rotating weighty mass."

There being no intermediate disturbing element between the point at which the film passes over the uniformly rotating cylinder, the uniformity of motion is obviously transmitted up to the point of translation.

Q. 160. Will you state approximately at what speed the film moves through both of these machines at the translation point?

A. As I understand it, the normal film speed today is ninety feet a minute.

Q. 161. Will you please proceed to apply Claim 13?

A. (Reading): "An apparatus for reproducing speech, music or the like sounds from vibrations recorded on a film, by the use of a line of light varied in accordance with the sound . . ."

The line of light is shown in Figure 1 at the area of translation, and variation is produced by the varied optical transmission of the film.

(Reading): ". . . comprising a photoelectric cell . . ."

The photoelectric cell is shown to the extreme right of Figure 1'.

(Reading): ". . . means for imparting to the film a rapid and uniform motion longitudinally of the film past said cell . . ."

Several co-operating elements tend to do that. The film is driven by the continuously driven sprocket, and the irregularities of motion are ironed out by the

smooth cylinder in conjunction with the flywheel and the tension springs.

(Reading): ". . . a source of light projection for providing said light . . ."

This is shown as the objective lens and the illuminated slit behind the objective lens.

(Reading): ". . . and an objective lens in the path of said light, and spaced from the film . . ."

The objective lens is so labelled on Figure 1, and a free space is shown between it and the film.

(Reading): ". . . for directing said light as a converging narrow line impinging on the film at a point in the region of the focal point of said lens . . ."

This is shown by the converging lines indicating that the line of light is converged at the film to a narrow line.

(Reading): ". . . said light passing through the film and on to said cell, the space between said lens and the film being free of obstructions to said light."

The light passes through the film on to the photoelectric cell, and there is no source of obstruction between the objective lens and the film.

(Reading): ". . . wherein a flywheel is operatively connected with the film through means which imparts uniformity of motion of the flywheel to the film."

That is, as has been previously explained, the flywheel is rigidly connected to the uniformly rotating smooth cylinder, and imparts the uniformity of its motion to the cylinder and the film.

Q. 162. Now, Claim 17, please.

A. (Reading): "In phonographic apparatus in which the sound record is formed on an elongated carrier of inconsiderable mass, the combination of means for supporting and progressing the elongated carrier from one point to another point, and past an intermediate point at which the record is made on the carrier

in recording or from which the record is taken from the carrier in reproducing . . ."

The claim thus far has been already explained.

". . . including a cylinder over a portion of the periphery of which the carrier passes adjacent to said intermediate point . . ."

The film passes over the periphery of the uniformly rotating cylinder Figure 1′ adjacent to the intermediate point, since there is no disturbing element between the contact of the film with this roller and said intermediate point.

(Reading): ". . . a flywheel operatively associated with said cylinder . . ."

The flywheel in this case is connected rigidly to the same shaft that supports the cylinder.

(Reading): ". . . said carrier progressing means operating to advance the carrier past said intermediate point at uniform speed under the control of said flywheel."

The film is progressed past the area of translation under the control of the uniformly rotating smooth cylinder, the flywheel associated therewith, and the tension of the spring.

(Reading): ". . . wherein a sprocket engaging the carrier forms a part of the carrier progressing means . . ."

The sprocket engaging the carrier is shown and labeled as "continuously driven sprocket" in Figure 1.

(Reading): ". . . and a substantial portion of the periphery of the cylinder . . ."

In this case the substantial portion is perhaps two-thirds of the total periphery of the cylinder.

(Reading): ". . . is in contact with the carrier in its travel from the intermediate point to said sprocket."

The intermediate point being indicated as the "area of translation." It can be seen that this cylinder is between the intermediate point and the carrier progressing means to the sprocket referred to in the claim.

Q. 163. Take claim 18 next.

A. (Reading): "The method of translating sound or similar vibrations to or from a film record by the use of light varied in accordance with the sound, comprising rapidly advancing the film past the point of translation . . ."

The film is rapidly drawn past the point of translation by means of the continuously driven sprocket.

(Reading): ". . . and subjecting the motion of the film in passing said point, to the control of inertia means to effectively eliminate irregularities in the movement of the film."

The inertia means in this case is the flywheel and is so marked and which is rigidly connected to the uniformly rotating smooth cylinder shaft which reacts with the film.

(Reading): ". . . wherein the inertia control is effected by passing the film over a rotating member and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

The film in passing around the uniformly rotating cylinder, which is directly connected with the flywheel, is given a uniformity of motion in accordance with the inertia effect of the flywheel.

Q. 164. And does that have the effect of eliminating substantially all the irregularities in its rotation?

A. It does.

Q. 165. Take claim 19, and just start it with the words "in which the film is yieldingly pressed," and so forth.

A. (Reading): ". . . the film is yieldingly pressed into contact with a supporting area immediately adjacent the point of translation . . ."

The curved supporting area can be seen above and below the point of translation, and into which the film is yieldingly pressed into contact by means of the flexible tension springs which are so labeled on the drawings.

(Reading): ". . . such pressure cooperating with the inertia control in the elimination of irregularities in the film motion."

The pressure of the tension springs induced a tension, as the name of the spring would indicate, a tension on the film which causes it to adhere closely to the uniformly rotating smooth cylinder shaft, and also brings the natural elasticity of the film into play to take out further slight irregularities, such as may be present.

(Reading): ". . . wherein the inertia control is effected by passing the film over a rotating member and so applying inertia thereto as to eliminate substantially all irregularities in its rotation."

The film is passed around the periphery of the uniformly rotating smooth cylinder, which is directly connected to the flywheel, as indicated in Figure 1, and the inertia effect of the flywheel is therefore transmitted to the uniformly rotating smooth cylinder, and hence to the film.

Q. 166. And the general disclaimer to the patent that I have referred to or read into the claims in no way affects your application?

A. No, it does not. Because this record is one whereby sound is translated by light to or from a film strip moving uniformly past that light.

Q. 167. You have testified, I believe, from your actual familiarity with the art and your research work in the literature of the art. What have you to say as to who were the first to present or demonstrate to the public satisfactory working apparatus enabling the

system that you have referred to as photographic sound on film sound pictures by a light-line?

A. From my knowledge of the art, gained in various ways, as far as I am able to determine, the first satisfactory presentation of this type of apparatus was made by the inventors of the patent in suit in Germany.

Q. 168. Professor, in Figures 1 and 3 and 4 of the patent in suit are the small rollers there $dr_1$, $dr_2$, in Figure 1, and e and g in the Figures 3 and 4, stationary or spring-pressed rollers?

A. They are spring-pressed rollers.

Q. 169. Please state your reason for that answer.

A. The film has to be spliced at periodic intervals, which means that a double thickness of material must pass under the rollers. Obviously, if there were no elasticity to the mounting of the rollers, this would prevent the splice from passing through. Hence, it is obvious that they must be spring-pressed.

Q. 170. In view of the function the patent ascribes to those rollers?

A. Yes.

Q. 171. And what is that function?

A. Of seating the film onto the sprocket piece and thus eliminating vibrations due to tooth engagement.

Q. 172. That is, the patent says they press the film onto the roller?

A. Press the film onto the roller.

Q. 173. Yesterday you applied Claim 17 to Figure 2 of the drawings, and Mr. Neave asked you if you could state whether the claim was applicable to other figures of the patent, and you said that you had not given the matter mature consideration yet. Have you considered that matter since and, if so, state what, if any, other figures Claim 17 is applicable to.

A. I have considered it in the meanwhile, and believe that Claim 17 applies to Figure 1 as well as Figure 2.

Q. 174. In your testimony you applied Claim 7 of the patent to Figures 5 and 6, which is the claim that shows the details of the spring connection. Is it also applicable to any other figures if the spring drive shown in Figures 5 and 6 are applied to those other figures?

A. Yes, it is, assuming the spring drive to be applied, Claim 7 would therefore read on Figure 1 and also Figures 3 and 4.

Q. 175. You called my attention to the part of your testimony in answer to Question 66, commencing about at the first paragraph on page 276, and stated that you would like to amplify or correct the impression given in that part of the answer. Will you please refer to that testimony and state what you want to in that regard?

A. When this invention is applied to sound pictures, the film passes through the projecting mechanism as well as through the sound reproducing mechanism, and obviously the same number of feet must pass through the sound head as passes through the picture head. There are four perforations for each individual picture, and each time the picture is changed the film is pulled down by a distance of four perforations. If the film is new and has not had a chance to shrink, the distance between these four perforations will be of one value. If the film is old and has shrunk, it will be something less than the other value. The picture projector does not take cognizance of this difference in the spacing of the projections, but merely pulls down four projections each time a new picture is shown. Since the film must pass through the sound head with the same number of feet per minute, the amount of the film which passes through the sound head is determined by the spacing between the projections, the perforations on the film, rather than by the linear measurement of the

film. In other words, we put the film through at a rate of so many sprocket holes per minute rather than at a rate of so many feet per minute, because the picture head determines the fact that four sprocket holes correspond to one picture, and if the picture head is making so many rotations per minute on its driving shaft, the speed will be determined by the number of sprocket holes rather than the actual length of the film. It is quite obvious that variations in the speed of the projection of the pictures has little or no effect upon the operation of the apparatus: that is, we may have twenty-four pictures per second or twenty-two pictures per second without having made any appreciable change, as far as the viewer is concerned.

Q. 176. You were testifying yesterday in regard to the defects or, let us say, the distortion in the focus of the line of light on the sound track closely adjacent to the sprocket holes, due to a distortion in the part of the film surrounding those sprocket holes. Will you please make an enlarged sketch illustrating that and show it to the Court, so I may put it in evidence?

A. (Witness made a pencil sketch.) This sketch, which I have marked for identification, shows a much enlarged view of what would happen if we were to take a sectional view down through the film directly through the point at which a perforation is located. I have not room on the paper to show the other list of perforations here. This perforation, of course, is much enlarged. If we were to cut the film down through the center of these perforations and look at the sectional view, you would find that the edges have a tendency to bend over, due to the presence of the emulsion on the film, the emulsion shrinks and tends to bend the film inwardly.

This edge should be bent over perhaps a bit more here (marking on drawing).

The sound record, being located very close to the perforation—I am showing it touching the perforation

here, which is not exactly the case; this heavy black line representing the sound record—will be bent over.

There is a tendency for the edge of the sound record to be bent at the edge which is nearest the perforation, which would make the line of light out of focus over the entire length of the sound record.

Now, by bending the film arcuately—as I showed yesterday—this bend at the point of the sound record is largely eliminated and the sound record is flattened out so that the line of light may be focussed exactly over its entire length.

Q. 177. Will you mark a light-line showing the ends of what you have there as a sound record? Put an arrow between them.

A. (Witness marks on sketch.)

Q. 178. Now, when you say the curving of the film will take out the curve or bend in this portion of the sound record closely adjacent to the sprocket hole, you mean the curving of the film in its longitudinal direction?

A. Yes.

Q. 179. Over the sprocket?

A. The film in general can curve in but one direction at a time.

Q. 180. And the curve at the sprocket hole that you are talking about is in the transverse direction?

A. Yes.

Mr. Ward: I offer the sketch made by the witness in evidence as Plaintiffs' Exhibit.

(Received in evidence and marked Plaintiffs' Exhibit 32.)

ALBERT KINDELMANN, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

My name is Albert Kindelmann, and my residence is Floral Park, Long Island, New York. I am chief engineer, International Projector Corporation, New York City.

The International Projector Company has been in existence about twenty-four years. I beg your pardon. About eight years for the International. The Precision Machine Company and the Nicholas Power Company were consolidated to form the International Company about eight years ago.

The name of the projector manufactured by the Precision Machine Company was Simplex Projector. I was in the employ of the Precision Company about fifteen years, and with the International Company since that time.

That is the Simplex model machine. The first machine built by the Precision Machine Company. The number of this machine is 100. That appears from the machine itself. There is a name plate on the side, or should be. On one side there. I first saw this machine when I first came with the company in 1910. The machine has been in the possession of the company ever since that time. As to why this particular machine was kept it is the model machine, the hand-made model machine and is used only for demonstrations in particular places where models are usually shown—a museum machine. That machine was never used in theatres. It was used simply for model demonstration of the first model machine at the offices of the company or any fair—wherever they may have been at times; there were always different demonstra-

tions in different towns: Chicago, and so forth. And the machine always went there or wherever it may have been.

The principles of operation of this machine are identical with the Simplex machines which are in use today. The purpose of the flywheel on the intermittent in this Model 100 machine is to move the constantly rotating flywheel shaft in the intermittent, uniformly. The purpose of the film trap or gate is to keep the film flat against the film trap in focus and to apply the proper pressure for that purpose. What is known as and we call the pressure pads applies the pressure. These two pads right here. They are springs. They are under spring-tension. The purpose of the small roller at the top of the film gate is to guide the film across the aperture in correct relationship.

MR. ASHTON: I offer in evidence the No. 100 Simplex projector of The Precision Machine Company as Defendants' Exhibit 1.

(Received in evidence and marked Defendants' Exhibit 1.)

This is a copy of the 1914-1915 catalogue of The Precision Machine Company, Inc. The intermittent movement, including the flywheel, is shown and described on page 10 of this catalogue. The film trap or gate is shown and described on page 11 of the catalogue.

MR. ASHTON: I offer the 1914-1915 catalogue of The Precision Company in evidence as Defendants' Exhibit 2, and ask that a copy may be substituted for the original.

(Copy received in evidence and marked Defendants' Exhibit 2.)

This is a sectioned model of the Simplex intermittent movement. As to whether there are any dif-

ferences in construction between the intermittent movement in the No. 100 machine, Defendants' Exhibit 1, and this sectioned model, just mechanical differences; not in movement. Just in construction. There are no differences in principle of operation.

MR. ASHTON: I offer in evidence as Defendants' Exhibit 3 the section model of the Simplex projector.

(Received in evidence and marked Defendants' Exhibit 3.)

The sectioned model, Defendants' Exhibit 3, is the present commercial form of the intermitten movement.

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RUDOLPH C. KNEUER, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

My name is Rudolph C. Kneuer. My residence is Ozone Park, Long Island, New York. My present occupation is assistant sales manager, International Projector Corporation, New York. It will be twenty-one years in August that I have been with the International Company and its predecessor, the Simplex Company.

Not more than 100 Simplex machines had been sold when I entered the company's employ. The sales records of the International Company come under my control. The book which I have here is a sales record book of the International Company. As to whether it appears from this book when No. 100 Simplex projector was made, I have a record of Machine No. 103, which was made in August, August 25th, 1911. And

while it does not show the date the model was made, it was made prior to that date.

Q. 9. How do you know it was prior to the date which you have given?

MR. WARD: I will stipulate that the machine was made at approximately the time they say it was.

MR. ASHTON: I offer in evidence the page of the sale record, being of the Simplex Machine Company referred to by the witness, containing an entry with respect to the Model No. 100 machine, and ask that a copy may be substituted; that it be marked Defendants' Exhibit 4.

(Copy received in evidence and marked Defendants' Exhibit 4.)

I have ascertained from the records of the company how many Simplex projectors of this type have been sold up to May 1st of this year. The number is 34,575. About 16,200 were sold prior to March, 1921.

MR. WARD: No cross-examination.

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ALBERT KINDELMANN resumed the stand.

CROSS-EXAMINATION.

By MR. WARD:

I am familiar with this model. I am a mechanical man. This device that I have my finger on is the flywheel. This thing I have my hand on here is the main driving gear. It is just slightly to the left and below that flywheel. The approximate size of the flywheel with respect to the main driving gear is probably about a quarter of an inch difference in diameter. The driving gear is the larger. I put my fingers on the periphery of the driving gear and feel the thickness.

And I feel the flange inside of that outer thickness. I feel the flange of the flywheel and feel the rim of the flywheel. The driving gear is the heaviest. But that does not mean anything. With regard to the large gear which is on the shaft immediately above the flywheel shaft: the diameter and thickness of that gear is about the same as the main driving gear. I put my fingers on the flywheel. I hear and note quite a lot of backlash in the gearing there.

The flywheel is on a continuously rotating shaft. The gearing between what I term the constantly rotating flywheel shaft and the sprocket in the model, Defendants' Exhibit 3 is just made a little heavier on account of the present-day running of motion picture machines than the construction in this model, Defendants' Exhibit 1.

There is no sprocket on that flywheel shaft driving the film constantly. There is no sprocket on that flywheel shaft engaging any film. The sprocket I referred to, which engages the film, is on an entirely different shaft. That is known as the starwheel shaft. The flywheel shaft makes revolutions while the starwheel shaft is standing still. The flywheel shaft is continuous running. The sprocket shaft is not continuous running. It has an intermittent motion. It stops when the pictures are projected and starts off to move the next picture before the gate.

XQ. 61. Now will you take your hand and put it on this flywheel shaft, the knurled part, and tell me if you do not feel a considerable variation in the friction of those gears, a considerable variation to lower that flywheel shaft as you turn it over.

A. Well, there is friction there.

XQ. 62. Well, I said a considerable amount of friction.

A. Well, that is not so. That is not in the gears. It is in the bearings and so on, you must remember

here that is a model here, there is no oil in the bearings; the bearings are dry, all your gears are dry, so therefore you are getting undue friction, which would not be in the intermittent if it were properly oiled, which the intermittents are.

XQ. 64. Will you take hold of that, in view of your last statement, and turn it and see if you don't find considerably more friction when you get the load of the moving intermittent sprocket which is not present when you are not moving your sprocket.

A. You do get more.

The oiling would not stop that irregular load on the flywheel, but you are adding irregular load without the oil. But you do have irregular load, oil or no oil.

I stated that the flywheel is on the shaft which drives an intermittent moving sprocket.

There are other sprockets in this machine that engage the film. They are constantly rotating sprockets. They move all the time without stopping. There is no flywheel on those shafts. Not on either one of them. It was not put there because those sprockets are only feed and takeup sprockets. Hold-back, in other words, I meant to say, instead of takeup, hold-back sprockets. They feed the film or hold it back. The sprocket with which you have the flywheel geared there through the intermittent gear is the sprocket that is driven by the intermittent motion. The advantage of putting the flywheel at that point is to create a uniform motion through the machine.

XQ. 79. Be sure to take that sprocket over?

A. Create a uniform movement.

XQ. 80. What do you mean by that?

A. Well, you see, you now have a movement which is now—as you say—more tension at one time and less at another time.

XQ. 81. Exactly.

A. Now, in order to overcome that particular ailment, a flywheel is necessary so that you can create a well-balanced uniform motion. And that is why the flywheel is put on the——

XQ. 82. That is a constant intermittent motion?

A. No, not a constant.

XQ. 83. A regular intermittent motion?

A. No, it is not. The flywheel has nothing to do with the intermittent motion.

XQ. 84. Hasn't it?

A. No. The flywheel eliminates that intermittent motion to create a uniform motion.

XQ. 85. This flywheel eliminates the intermittent motion on this sprocket?

A. It eliminates that which is caused by an intermittent motion. The machine does have to have an intermittent motion.

XQ. 87. And you say the flywheel eliminates it?

A. Yes, and it has got to have the flywheel to eliminate that undue—as you said before, it is an undue friction—to eliminate that undue friction and create a uniform movement, that flywheel is necessary.

XQ. 88. Didn't you admit that it did not eliminate the intermittent extra load?

A. I don't believe I did. If this flywheel is not on here the picture will stop and start properly. It will stop and start properly; it will project a picture. I mean by properly a picture that has no jump on the screen. If you take this flywheel off, your picture will have no jump on the screen.

XQ. 93. How will it be carried over from the period of obscuration to the period of illumination?

A. Due to a terrific, terrible jerky motion. The jerky motion would be right in here; right through here. The jerky motion is caused by the high ratio of gears at this driving point. It is caused by the inter-

mittent movement. A combination of starwheel and cam. We agree absolutely on that. What we can call the intermittent movement. And your flywheel is to take that movement over at different periods. To take it over when one of these parts tend to come to rest due to your star movement, and then the next time it goes around the flywheel is intended to smooth that operation out. It will smooth that out and make it run uniformly.

XQ. 102. Then it is for a uniform intermittent movement, isn't it?

A. If you wish to term it such.

XQ. 103. Well, that is correct, isn't it?

A. It is still uniform motion, though.

XQ. 104. It is the uniform intermittent motion as distinguished from a continuous uniform motion?

A. Well, if you wish to term it in that manner.

XQ. 105. You have been talking to counsel on the other side about this case, haven't you?

A. Well, that is quite natural that the counsel would ask me my opinion; but he cannot alter my opinion.

XQ. 106. If I asked you that question before you ever heard of this case, that this flywheel was to produce a uniformity in the intermittent motion—stop and start motion—you would have said yes, wouldn't you?

A. Uniformity?

XQ. 107. In the intermittent motion.

A. Naturally it would cause a uniformity. I see a flyball governor on this model on the vertical shaft on the same side of the machine as the flywheel. All the governor does is to raise the automatic fire shutter and to allow it to drop very quickly. This governor controls nothing but the automatic fire shutter. The automatic governor has no effect whatsoever in changing the load on that machine.

XQ. 113. Now I will ask you to please put your hand on the flywheel and jiggle it back and forth, and then come over here and put your hand on this sprocket here at the lower end of the machine. What is that?

A. That is the hold-back sprocket. That holds back the film from being advanced too quickly into the lower magazine.

XQ. 115. Now, keep your finger on that hold-back sprocket and take your hand and jiggle that flywheel through part of an arc, and tell me if you do not find a very decided backlash or looseness between the movement there and the movement down here.

A. There is. Decidedly. Quite a lot of play between them?

XQ. 117. Now will you put your hand on the upper sprocket on the side of the machine away from the flywheel and state what that sprocket is.

A. This is the feed sprocket. That is the thing that feeds the film to the mechanism. To the gate, yes. Say to the picture gate.

XQ. 120. Now, place your hand again on the flywheel and jiggle it back and forth and see if there is not a substantial amount of looseness and backlash and play there.

A. There is.

XQ. 121. And you have already testified that the same thing, under a considerable amount of rotation of the flywheel, between the flywheel shaft and the intermittent sprocket, exists?

A. No. No, I did not; not to the intermittent sprocket.

XQ. 122. Put your hand on the flywheel; take hold of the intermittent sprocket. Can't you turn the intermittent sprocket quite an appreciable distance back and forth without moving this intermittent sprocket at all?

A. Well, naturally it is an intermittent movement, you must have that.

XQ. 123. Now, take and move the flywheel up to the point—I have it there now—where it engages the intermittent drive so as to be ready to turn over the intermittent sprocket, and hold your finger on the intermittent sprocket; take the flywheel in your hand and see if you don't feel a perceptible play there.

A. In this particular model, yes.

XQ. 124. And that was the model you said was the model you have been putting out for years?

A. This particular model? Oh, no. I said this was the model machine.

XQ. 125. Yes, like the one you have been putting out?

A. This is the one being put out. (Indicating Exhibit 3.) This model, Exhibit No. 3, was built about eleven years ago. This intermittent sprocket on this model was put on at the same time. About eleven years ago, I am sure. It has been in the possession of the factory, who use this model for demonstration. That cap on the end of that shaft has been in that machine eleven years. That is an aluminum cap, duraluminum. It has not been in my possession during that time. In the possession of the company. I can state to my knowledge that there has been no change in the construction of this model with respect to that sprocket since it was built. As to how I can so state, well I happen to know these particular models when they were made.

XQ. 135. If somebody substituted another sprocket there you would know it, of the same size and shape?

A. Well, I probably couldn't say that. The shaft on that governor is geared to the rest of the machine gearing. As to whether I would say that that governor

has any flywheel action, well any governor would have a flywheel action. Not necessarily on the machine. Because, you see this particular model here, or in fact any other model after that, this here is stopped at a certain point on the inside with the tube. So that there is absolutely no centrifugal force applied outwardly, only up to that particular stop. From the point where the governors are closed down as they are now, to the maximum movement out, there is a variation in the inertia effect, due to the varying distance of the center of the mass from the shaft outwardly. That is not what a flywheel is supposed to do. A flywheel is a constant.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

In sound picture machines, as used today, the film travels through the machines at approximately ninety feet per minute. The flywheel on the intermittent movement makes 1440 revolutions per minute. Per second, twenty-four. The sound sprocket makes twenty-four revolutions per second. As to the speed of the two gears referred to in cross-examination, the lower one only makes ninety revolutions per minute, which is the main driving gear; and the upper one makes 360 revolutions per minute, which is known as the intermediate gear.

RDQ. 148. Have a large number of the machines which Mr. Kneuer referred to as having been sold prior to 1921 had intermittent movements identical with the intermittent movement of Defendants' Exhibit 3?

A. Yes, there were quite a few.

I can operate this projector by hand (and does so). (Witness turns handle.)

MR. ASHTON: He is turning that. Your Honor, we are going to take the flywheel off and show the difference.

If your Honor cares to just turn the crank a moment, and turn it again when we take the flywheel off?

(The Court turned the handle.)

MR. ASHTON: You will see the carry-over.

(Mr. Ward and Mr. Ballard turned the crank handle.)

RDQ. 154. Well, put a piece of film in the machine and turn it again with the flywheel on and then with the flywheel off.

A. (The witness complies.)

MR. ASHTON: The film has now been placed in the modern Simplex projector. Would your Honor care to turn the crank with the film in?

THE COURT: Yes.

MR. ASHTON: The flywheel is on now with the film as it would be used in the theatre.

RDQ. 155. Will you take the flywheel off?

MR. NEAVE: Now, if your Honor will turn that again with the flywheel off.

THE COURT: Yes.

RDQ. 156. Can you describe briefly for the purposes of the record the difference between the way the machine acts when the flywheel is on and the way it acts when the flywheel is off?

A. Well, you see, now you have, of course, what is known as the intermittent movement without anything to carry over that intermittent motion, so in order to get the movement carried over smoothly, to overcome that jerk or uneven tension, as you may call it, a flywheel is necessary, and that creates the uniform motion.

MR. WARD: Your Honor, I would like you to feel the weight of the flywheel, Defendants' Exhibit 5, that came out of that Simplex machine.

MR. ASHTON: I offer in evidence the modern Simplex projector used in the demonstration, as Defendants' Exhibit 5.

(Received in evidence and marked Defendants' Exhibit 5.)

MR. WARD: Now will your Honor feel the weight of that flywheel?

THE WITNESS: That is the flywheel that goes around twenty-four times per second.

RE-CROSS-EXAMINATION.

By MR. WARD:

RXQ. 157. Did you say that the sprocket in the sound head of a sound picture machine rotated at twenty-four revolutions per minute?

A. No. Six per minute. Did I say twenty-four? I stand corrected.

MR. ASHTON: You mean per second?

THE WITNESS: Per second.

RXQ. 158. Is it six or twenty-four?

A. It is six per second.

RXQ. 159. And what is it that rotates at twenty-four per second?

A. The intermittent.

RXQ. 160. The intermittent what?

A. The intermittent movement or the intermittent sprocket.

RXQ. 161. The intermittent sprocket?

A. The intermittent sprocket.

MR. WARD: That is all.

By Mr. Ashton:

RDQ. 162. You mean the flywheel, do you not, Mr. Kindelmann, that rotates twenty-four revolutions per second?

A. Yes, the other is twenty-four pictures per second. One is twenty-four pictures per second and the other is twenty-four revolutions per second. That is the flywheel.

RDQ. 163. That is, the film which is moved by the intermittent movement, projects twenty-four pictures per second?

A. That is right.

RDQ. 164. And the flywheel moves twenty-four revolutions per second?

A. Yes.

RDQ. 165. In your previous testimony you were referring, were you not, to the lower continuously rotating sprocket in the projector, as revolving twenty-four revolutions per second rather than the sound head?

A. Oh, yes, I was referring to the projector.

RDQ. 166. Is there any provision for adjustment for movement of the gears in the Simplex projectors, for wear, for example?

A. A provision is made for the wear? Not in the Simplex projector. There are one or two places where there is an allowance for wear, gear wear, but not throughout.

RDQ. 167. Will you point to some of the adjustment features on the machine?

A. Well, the adjustment features—just for gears are you speaking of?

RDQ. 168. That and anything else you care to mention.

A. Well, of course, for shutter adjustment, we have a set collar on that particular shaft. That has been taken off here, but there is a collar to take up any

end shake in the shutter shaft, which is naturally very important. If there is too much clearance in the shutter, we will get what is known as a travel on the picture; therefore, there cannot be too much lost motion in the shutter. Then for gears we have what is known as a double bevel gear on the inside of the machine. That bevel gear can be raised or lowered to suit the particular gear or the particular driving gear, which is at the lower part of the intermediate gear. Then that intermediate gear itself, that is also held in place with a collar on the opposite side of the shaft to eliminate any end shake. The flywheel is also constructed to take up any end play or end shake whatsoever. In the intermittent movement the cam is also taken up with an adjustable collar.

By Mr. Ward:

RXQ. 169. In your redirect by Mr. Ashton, in an attempt to correct this revolutions per minute, did I understand you to say that the film sprocket at the lower part of this model, Exhibit 1, rotated at twenty-four revolutions per second?

A. You have 360 revolutions per minute and, if we take it by seconds, we will divide it by sixty, and we have six.

RXQ. 170. Didn't you say twenty-four?

A. No, I said twenty-four pictures. Twenty-four pictures per second from the intermittent.

RXQ. 171. I understood that. I also understood you to say in response to Mr. Ashton's question that this lower sprocket rotated at twenty-four per second. Didn't you say that?

A. I may have said so, but it cannot be so, because the feed sprockets or the takeup sprockets or the sound sprockets are 360 revolutions per minute. If we wish to find it by seconds we just divide it by sixty.

RXQ. 172. I just wanted to get you right on the record, because you have it several ways.

A. That is right.

RXQ. 173. There is no sound in any of these machines, is there?

A. Not in these two projectors, no.

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FERDINAND ELSBECK, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

My name is Ferdinand Elsbeck and my residence Glendale, New York. My present occupation is machinist for the International Projector. I have been connected with the motion picture projector business since 1908. I worked at that time for the Nicholas Power Company. That company was located at 20 Jacob Street, New York. My work for the Nicholas Power Company was manufacturing the parts. I continued with that work until the Powers Company was taken over by the International Projector Company, about 1928. I have continued as a machinist with the International Company since that time.

I worked on the first intermittent cam for the Nicholas Power Company beginning in 1908. No. 6. That is a No. 6 Powers projector. I worked on the intermittent movement in this type of projector. I made up the first cam for the Powers machine No. 6.

This is a copy of the 1910 catalogue of the Nicholas Powers Company.

MR. ASHTON: I offer the catalogue in evidence as Defendants' Exhibit 6, and ask that a copy be substituted.

(Copy received in evidence and marked Defendants' Exhibit 6.)

The No. 6 machine was first made about 1909. The purpose of the flywheel on the intermittent movement of the Powers machine is to balance the machine and give uniform motion to the instantly rotating shaft on the intermittent movement. The purpose of the pressure gate on the Powers machine is to hold the film flat on the aperture plate. The Powers machine is provided with a guide roller at the top of the gate. A guide roller on the top feed sprocket. And a guide roller on the lower feed sprocket. The Powers machines have always had flywheels on the intermittent movement.

This machine, Exhibit C for identification, is a sectioned model of the intermittent movement of a Powers projector. I can identify this particular intermittent movement as one which has been in the possession of the Powers Company since about 1909.

Mr. Ashton: I offer the section model of the Powers intermittent movement in evidence as Defendants' Exhibit 7.

(Section model of Powers intermittent movement, heretofore marked Defendants' Exhibit C for identification, received in evidence and marked Defendants' Exhibit 7.)

Mr. Ashton: I ask that the complete Powers machine referred to by the witness be marked for the moment as Defendants' Exhibit 8 for identification.

Cross-Examination.

By Mr. Ward:

The purpose of the flywheel on the intermittent motion of the Powers machine is to balance out the machine and give the uniform motion to the constantly rotating shaft on the intermittent movement. The pur-

pose of the flywheel in the Powers machine is the same as the purpose of it in the Simplex machine. Exactly the same. I heard the Simplex witness's explanation of its purpose. I agree with his testimony on that. I agree with his testimony when he was explaining the reason for the irregular and hard motion in the machine when he turned it over by the crank, without the flywheel on. And I agree with his explanation as to what the flywheel did to eliminate or help those difficulties at the intermittent movement.

XQ. 37. Will you please come down here and take hold of that flywheel in your hand and jiggle it, and look at the gearing over here on this side at the same time, and tell me if there is not a considerable amount of backlash or loose play?

A. There is.

XQ. 38. In this model, and in Exhibit 7, is the arrangement of the flywheel shaft and the intermittent sprocket with its gearing to the flywheel shaft, the same as in this machine here?

A. The principal is the same. This is an old style. This is a double bearing and this is a single bearing.

In Model Exhibit 7 there is only a single bearing for the intermittent sprocket, whereas in the Exhibit 8, there are two bearings for the intermittent sprocket. Otherwise the construction and movement is the same.

XQ. 41. How many constantly rotating, as distinguished from intermittent rotating shafts, have you in this machine, which have sprockets on them, which engage the film?

A. Well, on that part I am not familiar. I am familiar with making the parts for this movement.

XQ. 42. You mean you are not familiar with the Powers machine?

A. I am familiar with the machine, as far as that is concerned, but the technical parts of it——

XQ. 43. What is your business in the Powers plant?

A. Manufacturing the parts. That is in one department and this would be done in another department.

XQ. 44. All you know about the machine is the manufacture of this flywheel shaft with the intermittent sprocket Exhibit 7?

A. Yes.

XQ. 45. That is all you know about it?

A. That is all.

XQ. 46. In the whole machine?

A. Yes.

XQ. 47. And your testimony given is based solely on the fact that you are engaged in manufacturing the flywheel shaft and the intermittent sprocket shaft and the gearing between the two?

A. Yes.

XQ. 48. That is all you know about the matter?

A. Yes.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

RDQ. 49. You referred a moment ago in answer to my question and also in answer to a question by Mr. Ward, to the fact that the flywheel is on the instantly rotating shaft. You meant constantly, did you not?

MR. WARD: I object to that.

THE COURT: That is a little leading and I will have to sustain the objection.

RDQ. 50. Will you please state what you meant?

A. I meant the continuously running.

RE-CROSS-EXAMINATION.

By MR. WARD:

These machines are not hand-cranked machines, at the present time. I don't know when the motor-driven

parts were made. I don't know anything about the construction of the machine or its drive except these two shaft parts in Exhibit 7.

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HARRY G. WREDE, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

My name is Harry G. Wrede. My residence is Richmond Hill, Long Island. I am camera inspector with the International Projector Corporation. I entered the employ of the Nicholas Powers Company in May or June, 1912. I was manager of the projector repair department from 1912 to 1932. The machine which has been marked for identification as Defendants' Exhibit 8 is known as a No. 6 model Powers machine. I have here a record that will tell when the machine Exhibit 8 was shipped, with the exception of the intermittent movement which is in the machine.

MR. ASHTON: Note on the record that the machine contains the number 24,526 on the frame above the flywheel.

THE WITNESS: That was sold on May 2d, 1917, to the Universal Film Manufacturing Company of San Juan, Porto Rico.

MR. WARD: One minute. Are you in control of the books of the company?

THE WITNESS: I was at that time.

At that time I managed the repair department; that is, attend to the factory end as well as the correspondence and other details. In charge.

This book is a record of the mechanisms that were sold. These three books are. I had occasion to refer to these books quite frequently. As to why I referred to them, the machine is guaranteed for a period of one year, and when machines were brought in for repair—if they came within the year's guarantee period they were overhauled without any charge, and I had to refer to these books. I have a book covering the intermittent movement in this machine, Exhibit 8.

MR. ASHTON: Note on the record that the witness looked at the number on the intermittent movement and that the number is 26,506.

THE WITNESS: That machine was sold to the Y. M. C. A. for shipment to Paris on January 16th, 1918.

The first Model No. 6 Powers Projector was shipped on October 30th, 1909, to Miles Brothers.

MR. ASHTON: I offer in evidence as Defendants' Exhibits 9-A, 9-B and 9-C, the pages from the three books referred to by the witness, and ask that copies be substituted.

(Received in evidence and marked respectively Defendants' Exhibits 9-A, 9-B and 9-C.)

Over 44,000 Powers machines of the No. 6 type were sold. About 40,000 were sold prior to March, 1921.

This machine, Exhibit 8, has been used as a loan mechanism, that is, the person bringing in one or sending one in requiring the loan of one to use in the meantime, has been furnished with a loan head. The intermittent movement that is in the machine is not the same one which was supplied with the machine originally. From time to time it would be necessary to repair the head and, instead of repairing the old movement, which

is so badly worn, a new movement would be put in in its place and a later design would be substituted instead of the old design.

MR. ASHTON: I now offer in evidence the Powers machine previously marked for identification as Defendants' Exhibit 8 in evidence.

(Received in evidence and so marked.)

Q. 22. I show you a catalogue and ask you what you know about it.

A. Yes, we have had catalogues of this description on file in our office. This is evidently one that was there.

Q. 23. Is this a catalogue obtained from the files——

MR. WARD: I object to that as leading.

Q. 23. (Continued.) —of the Nicholas Powers Company?

A. Nicholas Powers Company.

MR. ASHTON: I offer the catalogue in evidence as Defendants' Exhibit 10.

(Received in evidence and marked Defendants' Exhibit 10.)

CROSS-EXAMINATION.

By MR. WARD:

I have seen this catalogue a number of times; I should say somewhere around about 1918. I saw it in 1918 in the files of the Nicholas Powers Company. As to whether that is the only connection I had with it, occasionally, you know, you would have to refer to this. People would come in with some sort of a discussion and you would refer to the catalogue. It does not concern anything that I did for my company; just merely a matter of keeping it on file in case there was

some information to be looked over. I do not know anything about whether my company supplies apparatus to the R. C. A. or to its affiliate, the R. C. A. Photophone Company. At the present time I am a camera inspector. Making tests; making tests on the leakage in the camera, and making tests on the film going through it. That is the photographic end of it. I am not a mechanical inspector. I have nothing to do with the mechanical part of it, purely the photographic end. I do not know whether my company supplies cameras to the R. C. A. or its subsidiary company, R. C. A. Photophone Company. I have nothing to do with the sales. I do not know where our products go to. They are all shipped out from the shipping department. The cameras I test are those coming through the production. In other words, I simply test the new machines as they come through for production. My having charge of the sales records ceased in 1932. I didn't have charge of the sales records. I simply had to refer to them. These sales records that I have here, I had to refer to them frequently, to ascertain who bought the machine and whether the guarantee was still on it.

XQ. 41. I understood you that you were only concerned in your work with the testing out of the new machines as they came from production, so far as the photographic end went.

A. Cameras, I am talking about cameras now. At that time, up to 1932, my end of it was the repair department. And I did at that time have charge of the repair department up to April, 1932.

MR. ASHTON: That is all.

I will state, your Honor, that the two machines which have been offered in evidence, the Simplex and the Powers, are the standard machines in use today in a large number of the theatres in this

country; and they have been used in these theatres for a great many years prior to 1921.

I also want to make it perfectly clear that this is the part of the machine which projects the picture and that the sound mechanism, the sound head, is a mechanism in a box which is below this projector; the picture film is in the reel above the projector and goes down through this machine and then into the sound head. The picture is moved intermittently through the projector by this intermittent movement, to which the witnesses have referred, and that down in the sound head, it is moved constantly past the point where the light strikes the film.

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ALBERT KINDELMANN, resumed the stand.

RE-CROSS-EXAMINATION (Continued).

By MR. WARD:

RXQ. 174. Mr. Kindelmann, you mentioned that these machines that you had here, models, were hand-crank models, and you ran them by hand crank, did you?

A. That is right.

RXQ. 175. Can you run a sound projection head satisfactorily by hand crank?

A. I would say no, not with the sound attached.

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LOUIS E. HAMMOND, called as a witness on behalf of the defendants, was duly sworn, and testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

My name is Louis E. Hammond. I reside in Brooklyn, New York. I am a chief projectionist of Warner

Brothers' Brooklyn Strand Theatre, also in Brooklyn. I have been connected with the motion picture business since 1898. I began work as a motion picture operator. I have been an operator ever since, with the exception of the years 1904, 1905 and 1906, when I attended classes at Columbia University. I did have a connection with the Edison Kinetophone. The latter part of 1912 I was engaged by Mr. Edison to act as chief operator in his laboratory and as an instructor. That was at West Orange, New Jersey. I was giving private demonstrations of the Edison Kinetophone, which was the Edison talking picture; and instructing the men selected by Mr. Edison to install and operate the apparatus in the field. These were men who were to operate the Kinetophones.

The first installation of an Edison Kinetophone was in the Colonial Theatre, which was one of the popular vaudeville houses in New York, situated at Sixty-second and Broadway, February, 1913. I attended the opening at that theatre. At the opening I had the general supervision of the work of the men who were actually running the apparatus. Synchronized talking motion pictures were shown at this exhibition. The exhibition was a perfect success. The sound and pictures were in synchronism perfectly. As to whether the exhibition was received favorably by the public, the audience was very enthusiastic. There were a great many other installations made after this initial showing throughout the entire United States and Canada in all of the principal vaudeville houses.

I remained in the capacity of instructor at the Edison plant until June, 1913. Then I was sent by Mr. Edison to Berlin, with a complete Kinetophone outfit, which consisted of a projector, phonograph, synchronizing device, and other necessary accessories. The Edison talking pictures were very favorably re-

ceived in Europe. I gave an exhibition of the Edison Kinetophone talking pictures to Emperor Franz Joseph of Austria. The Emperor was so highly pleased with the entertainment that he presented to me and to three others, gifts—the gift which I received was a gold watch. I have that watch with me (producing watch). The date when it was presented to me appears on the watch. The date is August 19th, 1913, which was the eighty-third birthday of Emperor Franz Joseph. This certificate of gift I received from the Emperor, about two years afterwards—the delay in the issuance of it being caused by the War. It is a certificate which attested the fact that I was presented with the watch. The certificate is in German. I returned to the United States in January, 1914. As to why I came back, the exhibition tour that had been arranged was completed; all of the territory of Europe had been sold to local buyers, of rights to manufacture under the Edison patents, and local technicians had been trained to take up the work where I left off. When I got back to the United States I returned to Mr. Edison's laboratory in West Orange. I was then kept busy giving frequent private exhibitions of the talking pictures and various other odd duties about the laboratory.

I was next assigned to the American Telephone & Telegraph Company by Mr. Edison to go to San Francisco and set up a Kinetophone outfit and give demonstrations in conjunction with the Trans-Continental Telephone Line, which was then being demonstrated in the Palace of Liberal Arts in the Panama-Pacific International Exposition. The telephone company acquired a complete Kinetophone equipment from the Edison Company for this purpose. The equipment was sent to San Francisco shortly after I arrived there. I set up the equipment and operated it during the Exposition. At the Exposition I gave

several demonstrations daily of the Edison talking picture in conjunction with the Trans-Continental Telephone demonstration. The Kinetophone part of the apparatus was operated at the Exposition from, I believe, about the middle of April, 1915, until December of the same year—it was the close of the Exposition. I exhibited the talking picture known as "The Birth of the Telephone." It was a subject made by Thomas Watson, who was an associate of Alexander Graham Bell in the early development of the telephone. In the Watson picture, Mr. Watson gave a description of how he first became acquainted with Professor Bell and of various experiments that he conducted in conjunction with Professor Bell and at the finish showed a picture of the model of the first commercial telephone that he had constructed for Professor Bell. The picture lasted six minutes. The sound for the complete picture was recorded on one record cylinder.

This machine, which bears the name Edison Kinetophone, is identical with the machine I used in San Francisco, with the exceptions that this machine is not supplied with an electro-magnetic clutch tripper. The magnetic clutch tripper was a device to enable the operator, who was in the projection booth, to start the record rotating as a given point appeared on the film. It was ordinarily operated by hand, by a man behind the screen. But there being only one record shown, the use of this magnetic tripper permitted the elimination of that extra man. So that one man could operate the equipment. The phonograph was located behind the screen. The picture projector was in the regulation booth provided for the purpose at the rear of the auditorium.

As to how the machines were started and thereafter kept in synchronism, the phonograph was situated behind the screen. The record was placed upon this mandrel. The reproducing point was brought

down upon the first thread of the record. The record was given a rotating movement by hand, until a knock was heard in the horn. That knock was the definite point that had been determined that would synchronize perfectly with a known point in the film. When the motor of the phonograph was started it drove all parts of the phonograph, with the exception of this shaft and this mandrel which carried the record. Over this pulley there was a very small round belt, which ran over a series of pulleys to a similar pulley on the side of what is known as the synchronizing device, attached to the projector.

The film was threaded into the projection machine, your arc was struck, the picture projected upon the screen. First appeared the title of the picture, followed by one second or one foot of opaque film. The first picture appearing upon the screen following that opaque interval was the spot in the film which coincided with the knock or tap which had been recorded into the record.

As that first picture appeared, a push button was pressed in the booth which operated the magnetic clutch which I have before mentioned. And the mandrel and record immediately came up to full speed. From that time on it was necessary for the operator only to turn his crank until he felt the pressure of a brake against a brake drum, and his synchronism was maintained absolutely perfect.

Mr. Ashton: I offer in evidence the machine referred to by the witness, which is marked Edison Kinetophone.

(Received in evidence and marked Defendants' Exhibit 11.)

I recognize the machine across the room, which bears the name Edison Kinetoscope. This is the projection machine known as the Model D, which I used

at the Exposition in San Francisco. I know that this machine, the Edison Kinetoscope, is the same one I used at the Exposition by the markings on the shutters. By markings upon the shutter. And the sprocket on the takeup sprocket shaft has been changed since that time. That is the only change that has been made. The machine is in the same condition as it was when I operated it with the exception of the absence of a chain to drive the synchronizer, the double sprocket which is normally on the bottom here, which was not necessary except when talking pictures were being used, and the absence of a motor which fastened on brackets between the front legs to drive the machine. The motor was attached between these front legs. It was on the floor right between the front legs and a slack belt ran from a motor situated on the floor over the pulley on the shutter shaft, which drove the machine.

The synchronizer which is on the machine is apparently identical with the synchronizer I used at the Exposition. Only one model was ever made, one type. As to how synchronism was obtained with the use of this synchronizer, the small round belt before spoken of as passing over the pulley on the main shaft of the phonograph, after passing over a series of very, very light pulleys, it passed over a pulley on the rear side. From this sprocket here to the double sprocket formerly mentioned—but not now on this machine—ran a chain. This lock nut was tightened and if an attempt was made to drive the machine without the phonograph running, the projection machine applied a brake to itself and it could not be run.

As the phonograph was run and the small belt from the phonograph revolved, this pulley, the brake was released, permitting the picture machine to be driven at just the proportionate speed to permit it to keep in step with the phonograph.

The brake is seen here, through a bell crank. The pressure of this shaft would apply to this beam and transmit the braking power to this drum. The action of the phonograph released that brake and permitted the picture machine to be operated. When my exhibitions were discontinued at the close of the fair, I made other demonstrations of the Watson picture with the Kinetophone. The same Kinetophone outfit which was used at the fair was then packed and we made a tour of the Pacific coast, from San Diego to Vancouver, B. C., stopping off at the principal cities, and gave demonstrations likewise in connection with the Trans-Continental Telephone demonstration.

These newspaper clippings are newspaper clippings telling of these demonstrations that were given on the Pacific coast. The demonstrations which I gave.

MR. ASHTON: I offer in evidence, as Defendants' Exhibit No. 12, the Kinetoscope part of the equipment used at the fair and by the witness subsequently.

(Received in evidence and marked Defendants' Exhibit 12.)

MR. ASHTON: I offer in evidence as Defendants' Exhibit 13, the group of clippings from the newspapers.

MR. WARD: I understand, Mr. Ashton, that those are offered merely to show what the newspapers had to say at that time, and not for the facts?

MR. ASHTON: That is correct. I ask that they be marked A to E inclusive.

(Received in evidence and marked Defendants' Exhibits 13-A to 13-E inclusive.)

MR. ASHTON: I also offer in evidence as Defendants' Exhibit 13-F pages 956 to 960 inclusive

of Munsey's Magazine of March, 1913, containing an article on the Edison Kinetophone.

MR. WARD: What is the purpose of this.

MR. ASHTON: Just a description of the Kinetophone.

MR. WARD: I object to it for any other purpose except to show what some publication may have said at that date.

MR. ASHTON: It contains a description of the Kinetophone as given by the witness, your Honor.

MR. WARD: Which witness, this one?

MR. ASHTON: No. I said a description. Such as given by the witness here. And also refers to the original demonstration of the Kinetophone at the Edison plant.

We have a stipulation which covers the dates of publications. Of course, they are subject to objection beyond that.

MR. WARD: I have no objection to the fact that this is not the original article, your Honor, but I do not want this to be put in evidence to prove statements made in here. He has got a witness here who testifies to the construction of the machine, how it operated; and he has got a witness on the stand that can testify to anything about this machine. I do not want to have an article written by a Mr. Marcosson, whom nobody knows, and is not on the stand, and have it alleged that these statements are true.

I do not know anything about them. I do not think Mr. Ashton does.

MR. ASHTON: It covers what was said at the time about the Edison Kinetophone, your Honor, and also proves the date when these things were being shown, as in March, 1913.

MR. WARD: Do you only put it in to show the date and to show what the press had to say about it on that day?

MR. ASHTON: Yes, what this magazine had to say about it.

MR. WARD: Not as establishing the facts stated therein?

MR. ASHTON: I don't know what you mean by that.

MR. WARD: I mean as any evidence of any facts stated herein.

MR. ASHTON: It certainly is evidence of what the public thought of the Kinetophone at the time in March, 1913, and it also establishes that the Kinetophones were being demonstrated and received favorably by the public.

THE COURT: Get your offer and your objection in shape now for the record.

MR. WARD: I object to it, your Honor, for any other purpose than to show what the publisher of this article thought at that time, and to show the date of the event. I will take it for those two and object to it for any other reason.

THE COURT: I am inclined, Mr. Ashton, to think that Mr. Ward's position is sound legally; in other words, you could not put a magazine or a newspaper article in to prove the substance of your main contention here as to these machines. You might show it as a part of the res gestae, probably what occurred at that time.

MR. ASHTON: That is is the principal reason for the offer, your Honor, to show what the demonstrations were, that they did occur at that time

and that this statement was made by a magazine writer regarding the particular demonstration.

THE COURT: You see, the best evidence would be that writer himself.

MR. ASHTON: That is quite true, your Honor.

MR. WARD: That is my objection. You can use the article probably to show dates when there was a demonstration put on. What the public thought—that writer might not, from what I know, have considered the demonstration——

THE COURT: The Court does not know. That only shows the soundness of the position of the Court on the law in not accepting this where there is objection, as proof of the construction or operation of the machines in question.

MR. ASHTON: It may go in as showing the date when a demonstratnon was made, and also as showing that an article was written at the time by a reporter who heard the demonstration?

MR. WARD: No. I object to the fact that the reporter heard the demonstration.

THE COURT: That an article was written at the time.

MR. ASHTON: That an article was written.

MR. WARD: I know that certain members of the public thought these demonstrations were terrible. People who looked upon it as a novelty may have thought that it was a wonderful thing.

THE COURT: Well, we will receive the article for the purposes indicated by the Court.

(Magazine article by Marcosson in Munsey's Magazine, March, 1933, received in evidence and marked Defendants' Exhibit 13-F.)

THE WITNESS: After I completed my exhibitions on the coast I returned to New York to the Edison laboratory. I made other demonstrations of the Watson picture with the Kinetophone after I returned to New York in conjunction with several lectures given by General J. J. Carty of the Telephone Company, and demonstration of various developments of the telephone. I have been employed continuously since as a motion picture projectionist by the Strand Theatre in New York and the Strand Theatre in Brooklyn. I don't know definitely when the Edison Company discontinued making pictures for the Kinetophone, but it was some time in 1914 or 1915. As to whether I know why they discontinued, I believe there were several contributing reasons, one of which was they had failed to maintain public interest because of the nature of the subjects that they were turning out, and probably the most important reason was because at that time there was no amplifying system known that would permit of the distributing of the sound evenly throughout a large house. The Kinetophone in its form at that time was rather limited to houses of certain shapes, in order to give what we would class as a satisfactory performance.

Q. 170. I gave about two thousand shows of the Watson picture with the Kinetophone at the exposition during the period that I was there. During the run of the exposition, there was but one time when the picture was out of synchronism and at Seattle on the trip that followed the exposition there was one occasion that it was out of synchronism. The failure of the one show at the exposition was caused by pitch dripping from the boards of the ceiling directly over the phonograph. A drop of pitch dropped on to the record, and everything was all right until the reproducer needle hit that pitch and everything went haywire. The one in Seattle was caused by neglect on my part to put the

retaining hook upon the record to prevent it from slipping. When the record was set in the morning the house was very cold and the record was set and everything was all right for the show at night, and I failed to check when I went back for the evening performance, and the temperature of the theatre had risen a considerable number of degrees, and the expansion had caused the record to become loose on the mandrel. I started the machine and the mandrel turned this record and failed to carry the record around with it. The hook to which I refer is the spring hook which I now have in my hand on Exhibit 11.

CROSS-EXAMINATION.

By MR. WARD:

This Kinetophone is a machine identical with the one I demonstrated in California. It is not the same machine I demonstrated. I don't know what has become of the machine I demonstrated there. There are no fundamental differences between the machine I demonstrated there and this machine which is of the same type. The one difference that does exist is that on the machine exhibited here there is no electromagnetic clutch or tripper which would permit the operator in the booth to start the record instead of requiring a man behind the screen performing that function. The machine that I had out there did not have a magnetic clutch; it was a magnetic tripper. The function of it was to pull down on the tripper lever under the base plate, doing exactly the same as a man would do, or a human would do if they pressed the button at the machine. The main driving pulley on the shaft carrying one part of the clutch was identically the same as this driving pulley here. My machine did not have a piece of metal on that pulley like you show me here, secured to this face of this pulley. I have no idea when that piece of metal was put on. My machine did

not have that. This large pulley here which I have my hand on is belted to the motor below. The belt that runs over this large pulley runs below, over the motor pulley, and another pulley, and there is a governor, a centrifugal governor geared to this extra pulley. The governor was to help to maintain exact speed of the revolving mandrel. Of the mandrel that carried the record as to how it did that, well, by centrifugal force, the weights attached to the springs of the governor would fly out from center. As they did so, they drew in a disc against two friction pads revolving at a rapid speed, and the drawing of that disc against the friction pads would add friction and load, thereby causing a slight slippage of the belt. That would iron out some of the inequality of speed in the motor.

XQ. 189. I don't quite understand how that would iron out some inequality of the speed.

A. By adding more load to the motor it would naturally slightly slow down the motor.

XQ. 190. You mean then that if your motor was running too fast, these ball governors would fly out and, through some friction discs, would supply a greater load on the motor and tend to check the motor down?

A. That would be true within certain limits. It would be a very narrow margin of regulation. There was to my knowledge no more important function of this governor. The governors would not function unless there was a change of speed in this belt which passed over the pulleys driving the governor. There would be a change of speed in this large pulley over here which the belt passes over if the governors did not work. The change of speed would probably take place at the source of power. It would take place at the source of power.

XQ. 195. If they are all geared together by the belt there would be some change of speed here at the

same time there would be down here at the pulley? That is the function of the governor, isn't it?

A. Very slight, except as the governors work to take up that change of speed.

The large pulley is loosely mounted on the same shaft as the mandrel upon which the sound cylinder was placed. It is not keyed there nor an integral part of it. In other words, I turn this cylinder and I hold the pulley still until the clutch functions.

XQ. 198. Then it is connected through a clutch. Will you clutch that in now, please?

A. (Witness complies.)

XQ. 199. Now, through a clutch connecting a hollow sleeve on which this pulley is mounted, the flywheel, as you call it, the large pulley, is connected through the clutch to this shaft?

A. That is correct.

XQ. 200. Which carries the cylinder?

A. Yes.

There should be no loose motion between the flywheel and the cylinder on which the sound cylinder was mounted. There is a very slight amount here.

XQ. 203. Well, about a half an inch of movement on the periphery of the pulley?

A. You are disengaging the clutch.

XQ. 204. I don't want to do that. I want to do it in this direction.

A. About half an inch.

I am familiar with present-day sound on film sound pictures only from an operating standpoint. I operate them every day. If I had a play of that extent between the sprocket which feeds the sound film, through the sound head, and the flywheel which is connected to those sprockets, I would say the result would be very bad, but there is an entirely different condition existing. An entirely different problem in the two types of machine. There is no question about that.

There you have, in the sound on film sound pictures, you have entirely different problems to meet. And that is due to the fineness of the lines constituting the sound track. And the effect of the light through those lines on to the photoelectric cell. I may add, however, that there is considerable backlash in what is known as the Movietone sprocket. If you want to take it in the same manner as you are taking this. By the Movietone sprocket I mean the sprocket which pulls the film down before the sound track, and immediately below the sound track.

I do not know the PS1 and PS16 type. Looking at this view here, the sprocket marked on Plaintiffs' Exhibit 16-A as "takeup sprocket," which feeds the film from the flywhel shaft into the take up wheel, is the sprocket that I am talking about, the one designated here as "flywheel shaft." I would not be prepared to say that there is backlash or looseness between the angular rotation of the sprocket corresponding to the sprocket cylinder so marked on this drawing, and the flywheel which is connected to it, in the sound machine which I operate. What I did mean was by taking hold of this particular sprocket, it can be moved circumferentially a certain amount. Taking hold of the sprocket marked "uniformly rotating sprocket cylinder." I did not refer to taking hold of the flywheel. I meant just taking the sprocket by itself, and there would be a natural freeness. I have not tried it with respect to the flywheel. I do not know that the flywheel and the sprocket are rigidly connected to a shaft in that machine. What I meant to say was, and all I meant to say was, if you took hold of the sprocket you could turn it a little bit. I cannot definitely say whether the machine I operate has a spring between the gearing and the flywheel that permits you to turn that sprocket and flywheel a little bit. I do not know what the construction is in my machine, of the

flywheel, beyond the flywheel, and the rest of the machine.

XQ. 226. You do know that the sprocket at this point is directly connected with the flywheel and shaft?

A. I don't know whether a spring exists between them or not. I don't know everything about the construction of the machine I operate every day.

I have been operating sound on film sound picture projecting machines I should judge about five years. I represent myself as a mechanical man. I took this Edison machine all over the world and demonstrated it. As to whether I have interested myself enough to look into one of these modern sound on film sound picture machines, we have let the mechanism quite severely alone and left it to the service men of the Western Electric Company to take care of that part of the machine. As to my function in these theatres that I am employed with now, well, I am entitled as the chief, but it really means that I simply project pictures, the same as the rest of the men in the theatre. We seldom have any troubles with our machine. I have never had occasion to open up that machine and see if the flywheel was not on a shaft rigidly connected to the sprocket.

XQ. 235. But you were sufficiently interested to put your hand in there and take hold of the sprocket and discover that there was a certain amount of annular rotative movement, presumably?

A. That was not done with any attempt to learn anything. It was incidental to the regular running of the machine. All of the sprockets are slightly loose.

XQ. 236. But you happen to have remembered that incidental try of yours quite distinctly when I asked you about the defendants' machine, Exhibit 11, didn't you?

A. I did, because it is an entirely different construction.

XQ. 237. Now, will you please come back to this machine, Exhibit 11, and tell me in what manner the stylus up on top of this machine, carrying the reproducing needle or serving as the reproducing needle—tell me what moves the carriages on which it is mounted, back and forth, with respect to the cylinder which carries the record—or does the cylinder move?

A. The cylinder moves in relation to the stylus.

And that movement is due to a fine feed screw shaft here, carrying what I might term a split threaded nut. That feed shaft is gear driven. Gear driven through two pinion gears.

XQ. 241. Spur gears. Three really, isn't it?

A. One driver and an intermediate and a driven.

One is on the mandrel shaft which rotates the record cylinder. It is splined on that shaft, so that it has to rotate annularly with it. Not necessarily without any play between the two. It is only a matter of making it possible to lubricate it. There was no backlash necessary. The intention was that this shaft, which carries the sound mandrel here, is supposed to drive this gear wheel around that shaft so that the two rotate annularly together. And then that sprocket in turn drives another spur gear, which in turn drives a third one which is on the shaft of this threaded shaft. When this machine is rotated by moving this large pulley, which is belted to the motor, this threaded shaft is turned through those gears. And it has to force the feed of this nut, this split nut back and forth. There is a certain amount of load in that on the driving shaft. That load is a constant one. And it serves to feed this stylus back and forth across the film. I am to a certain extent familiar with the action of these styluses working in the grooves of the record. I have observed the operation of the ordinary disc and cylinder gramophones. I have not observed on modern machines any change in the speed, any tendency of the

machine to slow down when the stylus hits a very high note. As to what I mean by modern machines, I used to notice it on the cheap cylinder phonographs that were sold in the old days without flywheel. I would not even venture to state a date. It would really be impossible to answer. Up to how late I would say I noticed it.

As to whether it was true of the Victor machines as late as 1915 that if you put a disc record on them and wound it up and started it off, that when they hit a high pitch you could detect the slowing up of the rotating element, I can't speak of the Victor. What I have in mind is the old-time Edison machines and those using the cylinder record. And those five or six dollar gramophones. Apparently those did slow up, yes. The rotation of the cylinder carrying the sound record was not kept absolutely uniform. It seems that way to me that when you hit the high note it slowed up. I would think that that would answer it that when it hit a low note it speeded up more.

XQ. 268. Well, you saw the machines?

A. I didn't make a close enough—on these machines here we never had that trouble.

As to what machines I had trouble on, I am referring to the little house machines that were constructed without, apparently without any mechanism built in to overcome that trouble. As to what mechanism is built here to overcome that trouble, this flywheel overcomes it, helps to overcome it. It helps to overcome it. As to whether it did overcome it entirely, it was overcome, either wholly by the flywheel or partially by the flywheel and partially by the governors. I do know—I have not got a record here for this machine. I do not know how the machine appeared here and not a record. I did not keep any of those records. I do not know where any of them are. I note there is a certain amount of play between that

cylinder and the shaft on Defendants' Exhibit 11. As to what the function of that, what the purpose of that was, in the operation of this machine, it was to have the mandrel slightly float to overcome a slight untrueness in the records. The records were filled with a plaster and they were not perfectly true, not as true as a lathe would make them—as a lathe would turn down. There is a certain amount of float. Your shaft passes clear through the mandrel and is pinned to the far end, and not at this end. That was necessary to smooth out the operation of this type of machine.

I am familiar with the sound on film sound picture system. I wouldn't state offhand, without trying it, what would be the effect on the reproduction of sound in the sound on film sound machines if we had any such play as that between the flywheel and the sprocket that drove the film through the sound head. A movement of that type would probably throw out several of the track lines that are only a matter of about a thousandth of an inch in thickness. There is a doubt about it in my mind.

XQ. 287. Well, you can measure it. How many thousandths, how many one-thousandths?

A. It would be many lines of mesh such as that——

I guess I read when it first came out, the instruction book of the Western Electric Company on the proper running or care of your sound head machine that you project with. When they first put them into our house, there were practically no instructions published, we were almost thrown upon our own. We were practically thrown upon our own. At various times bulletins were issued. I read them. Everything was running beautifully and, not having occasion to use much of the material in them, it just slipped the mind. We seldom called the service man. They make their regular periodic visits to our house. As to

whether I have ever interested myself sufficiently to read their instruction book, we have had no trouble in that part of the machine at any time.

In this old machine you have got to synchronize this cylinder with your motion picture machine, this Edison machine that we are talking about, Exhibit No. 11. They have to be synchronized. And when you get your motion picture machine started out, and you get to that mark that you spoke about, this machine has got to be running during that time and then you expect, at the signal on your film, you have got to snap this cylinder carrying the sound record into operation and rotation very quickly to its full speed. This large pulley does have a function to perform in that operation.

In other words, through the motor this large pulley is gotten up to its proper high rate of speed, and then when the signal comes—so to speak—or the control on the motion picture machines requires an immediate response from this sound cylinder, you rely upon the energy stored up in this large pulley here to snap that clutch through and have this cylinder pick up at approximately full speed right away. I think that is not the primary object of that big wheel. The disc would not be picked up as quickly without one. As to whether it would be anywhere nearly so quick. I haven't tried it, but I believe it would pick up quite quickly. It would slow down momentarily, but it would very soon pick up. There would be some lag in the time that this cylinder came up to its proper speed, if you did not have this big pulley on here.

I wouldn't venture to say whether there would be a substantial amount of lag. I am a mechanical man, but the load to be picked up is so light, purposely made light, that there was not a great amount of kinetic energy necessary to——

XQ. 309. What would happen if you did not have this big pulley here to pick that cylinder up quickly; what would happen if you did not have this big pulley and just relied upon your motor and a belt drive here to, let us say, a light wooden pulley? What would happen when you slammed that load on quickly?

A. There would be a slight slippage in the belt between the driving motor and the mandrel to be driven. There would be quite some slippage. With the flywheel on here that is substantially obviated.

I believe it was about 1914 that this machine went out of use to the public. Went out of use at that time because there were no amplifiers at that time. I got that information right from the Edison people at the time I worked for them.

XQ. 315. In 1914 they told you that they had ceased the use of these machines because there was no amplifier available?

A. That was one of the reasons.

I can tell you how I would use an amplifier on that machine (Exhibit 11). By the removal of the present reproducer and replacing it with a magnetic type of reproducer similar in construction to the present type of what is known as a phonograph pick-up, using the ball point reproducer needle instead of a steel needle, as it is used on the Vitaphone. I don't know when that did come in. I do not know definitely when it came in. The Edison people did not put it out. Later the Western Electric, I believe, had such a device. You could not use an amplifier on this machine if you tried to at that particular time.

We used that machine in California in conjunction with the transmission of speech across the continent at the Exposition. We used what is known as a Trans-Continental Telephone wire. I know that they used amplifiers for that purpose.

XQ. 324. So amplifiers did exist when you had that show in California?

A. They were probably adaptable to this use.

XQ. 325. Well, your whole machine was not adaptable to amplifier use at all, was it?

A. Correct.

XQ. 326. So that was not the reason why this machine had to stop operating, was it?

A. But Edison had not any amplifiers. Those amplifiers were the property of the Western Electric Company.

XQ. 327. But you could not have used them on this machine, could you?

A. I believe they could have been adapted to the machine very easily by the use of the aforementioned so-called phonograph pickup, and audion tubes, or—I know what I am talking about as to how I could equip the pickup and the audion tubes here. As to where I am going to connect it with respect to the stylus, just simply remove the entire reproducer, mount the magnetic reproducer or pickup above the mandrel, in the same manner that this is mounted, eliminating the amber roll shaft. And let it play on the same record I had on before. The amplifiers that were in existence could have been used.

XQ. 332a. Then it is not true that the machine went out of use because there were no amplifiers?

A. But Edison did not have those amplifiers, and it was an Edison product.

XQ. 333. Did you try to get amplifiers made for it?

A. That I do not know.

I was working with American Telephone & Telegraph Company at that time, before these things went out west, when I went to California. The A. T. & T. or a subsidiary company, Western Electric, owns the amplifiers that I was speaking about. They were the ones that transmitted the speech. The very people that I was working with had the amplifiers.

I said something about selling the rights to this all over Europe. We sold the rights to motion picture producers in the various European centers. They did adopt it. As to what extent they had advanced quite extensively until the beginning of the War, which stopped their operation. I was over there in 1913 until January, 1914. I believe the War broke out in July, 1914. I personally did not sell the rights. It was other representatives. I was only the technician. I was in on the conferences as to when they were sold, shortly after arriving there in June, 1913, at Berlin in June they started. Between June, 1913, and January, 1914, the rights were sold.

In this country Edison did the manufacturing and it was promoted through the American Talking Picture Company. I don't know who were the real backers. It was allied in some way with the United Booking Offices. I never demonstrated except for the telephone company in this country, little private shows. The only thing I had to do with it was for the telephone company. I was at the exposition as their employee. I said something about not having but two failures. I was only talking about the operation of the machine for the telephone company. As to whether I had anything to do with any operations of such a device by others in this country, in the early part of the game, the first month or so of its operation, I supervised the installation and operation in several theatres but did not actually operate it. It would only be a guess how many machines were installed. I would say probably a couple of hundred. In all of the principal vaudeville houses in the United States and Canada. I observed some of those demonstrations.

XQ. 360. Did you see some of the audience walk out during the demonstrations?

A. Toward the end of it, after I returned from Europe, I did.

XQ. 361. That was a frequent occurrence, wasn't it?

A. I believe it was, toward the end.

As to how many subjects I had recorded for demonstration, I had twelve with me in Europe. I do not know how many were produced after I left this country. The extent of the show would be six minutes per reel, per subject.

I believe the other machine (Exhibit 12, Kinetoscope) to be the exact machine that I had out on the coast. This chain sprocket of the takeup shaft has been changed for a single sprocket. It was formerly a double sprocket. As to why it has been changed to a single sprocket, I believe the machine had been disposed of, to be used for the running of silent pictures only. I heard that. I was asked if I wanted to purchase the machine some years ago; and I replied no, and I assumed that it was sold to someone else. I do not know when that was put on. This chain drive was on the old machine. I can see nothing more that has been changed. I do not know anything about the whereabouts of any of those old records that operated in this machine (Defts. Exhibit 11). I did not get this machine. I do not know where it came from. That is the same type of motor that was in the machine that I had. We had various motors that could be used to comply with local conditions. I do not remember the horsepower of it.

I stated that the exhibition of this machine was a perfect success. What I meant by that was that it was received with great enthusiasm by the audience. And I personally never had any major trouble. As to whether I mean that the sound reproduction was perfect, the sound reproducion of this machine was far superior to some of the earlier attempts at sound on film that Fox made. I mean that the quality of the

earlier Fox productions were extremely faulty, in my own opinion.

XQ. 382. Why the Fox productions? Why do you pick on the Fox productions?

A. Well, I say Fox were the first sound on films that came under my observation. Fox was the first of the sound on films. I cannot state just the date. I believe other theatres came out with sound on film as quickly as Fox Theatres. I know only indirectly that Fox is a plaintiff in this suit, or has got something to do with the plaintiff. That isn't the reason I gave that answer. It is a personal opinion. It is not nearly as good as our sound on film sound pictures today. We are using a Simplex machine, Warner Brothers Productions. We are using no further disc records for sound pictures for the past year.

To my knowledge nobody is using them. I saw the Fox sound on film production which I thought was not so good in the Fox Theatre in Brooklyn, which I believe is supposed to have been their pride. I cannot state the year; shortly after the installation of the equipment in that house. I would not say the sound production was as good as this old Edison machine here. It was not as good as the old Edison machine. I don't know whether the equipment used in that house was Western Electric equipment. I have never been in the projection booth. I don't know that Fox did not put out any apparatus himself. The name of that theatre was the Fox Theatre, Brooklyn. I don't know what the year was. Not as far back as 1926 or 1927. I don't recall the picture I saw. It does not apply to any one picture. There were several I saw. Some were better than others. I believe that the quality of this Edison machine, Exhibit 11, was consistently better than the average of the pictures turned out at that time. I was quite interested when I first saw

sound on film pictures. I cannot tell you the subject of a single show that I saw. That is a good many years ago.

XQ. 411. It is not as many years ago as you ran this instrument here?

A. I ran this continually for a long, long time.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I testified on cross-examination that I was paid by the Telephone Company while I was working at the exposition. I was also paid by the Edison Company to supervise certain installations that the Edison Company had in State exhibits at the exposition. As to what I meant when I said the Edison machine and modern sound on film machines were different I believe I was referring to conditions, the mechanical conditions being vastly different between the two processes. The modern machine uses sound on film. The Edison machine uses cylinders; a cylinder record. That is what I was referring to. The modern machine has a flywheel on it. The Edison machine has a flywheel. As far as I know there was no difference in the function of those two flywheels.

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GEORGE K. THOMPSON, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I am sixty-eight. I was connected with the American Telephone & Telegraph Company for forty-eight years. The first ten years I tested receivers and transmitters. The remaining thirty-eight years I did development work on receivers and transmitters and

associated apparatus. I also was responsible for bringing together electrical and mechanical apparatus and moving picture equipment for the various expeditions made by the Telephone Company.

As to what I had to do with the exposition at San Francisco in 1915 I brought together all of the apparatus that was necessary for that exhibit and shipped it out to San Francisco. I went to the Edison studios some time in March, 1915, with Mr. T. A. Watson, and there I saw a talking moving picture made of Mr. Watson with the Kinetophone system. I went to the exposition in the latter part of April, 1915. I went out to see that all of the apparatus was in working condition. I found everything working O. K. The Watson picture was reproduced from six to seven times a day. While I was there I remained a week. As to whether there are any differences between the machine Exhibit 11 and the one which I had at the exposition, the one that we had at the exposition had a magnetic tripping device for connecting the mandrel and the cylinder to the driving mechanism. The phonograph started at the fair by a push button in the booth.

After the fair was over the apparatus which we had used was packed in trunks and used for a series of demonstrations on the Pacific Coast. Some time in February, 1916, these trunks with the apparatus inside was sent to the Western Electric Company, where their contents were rechecked and the trunks were then sent to the Edison Company. The Edison Company, in the early part of 1918, advised the Telephone Company that they were or had gone out of the moving picture business, and suggested that we take back the equipment that we had at San Francisco, and an agreement was made between the American Telephone & Telegraph Company and the Edison Company for a lease taking over the equipment for ten years. That paper

is one of the original leases. This lease was executed about June 1st, 1918. I obtained the lease from the files of the Telephone Company. There is a paper attached to the lease. It gives a list of the apparatus that was included in the equipment which we took over from the Edison Company. It includes a large amount of repair apparatus in order that we could make our repairs, and also gives the code number of the phonograph which was used, and the code number of the Edison moving picture machine.

MR. ASHTON: I offer the lease and the attached list of material in evidence as Defendants' Exhibit 14.

(Lease between American Telephone & Telegraph Company and Edison Company with attached list of material received in evidence and marked Defendants' Exhibit 14.)

After the equipment was returned to the Telephone Company under this lease it was used between 1918 and 1924 or 1925 in connection with many demonstrations of the Transcontinental Line service lectures given by General Carty, the vice-president of the American Telephone & Telegraph Company. At these demonstrations the Kinetophone was used to show the talking moving picture. We kept the entire equipment until the latter part of 1926 when it was decided to dispose of all of it, so I requested the Western Electric Company to make the best disposal they could of the apparatus. The Kinetophone, the sound part, was destroyed. The projector was sold to the Community Church of Mountain Lakes, New Jersey. The Kinetoscope, Defendants' Exhibit 12, is the Kinetoscope used at the fair. The Kinetoscope, Exhibit 12, was recently obtained from the Community Church at Mountain Lakes, New Jersey. I went out there and found it in

the church and checked up the number and asked to have it sent in to the Western Electric Company.

This is a photograph of the original Kinetophone that was used at the fair and was also used between the years 1918 and 1924 or 1925. The picture was taken at my request by my assistant, Mr. F. J. Ward, for purposes of the file and for his own information. On the back of this photograph he has made a few notes describing the operation of the Kinetophone. The picture was taken early in the year 1921.

Mr. Ashton: I offer that photograph in evidence as Defendants' Exhibit 15.

(Received in evidence and marked Defendants' Exhibit 15.)

This other photograph, which was taken at the same time as the previous one, shows the application of an Edison synchronizer to a Powers machine, indicating how the synchronizer is connected with the driving mechanism.

Mr. Ashton: I offer the photograph in evidence as Defendants' Exhibit 16.

(Received in evidence and marked Defendants' Exhibit 16.)

The auditorium where the Kinetophone was exhibited in the American Telephone & Telegraph Company's exhibit at the fair in San Francisco in 1915 was about 50 feet long and 35 or 40 feet wide. It contained 178 seats.

Cross-Examination.

By Mr. Ward:

The writing on the back of Exhibit 15 was written in 1921 by my assistant, Mr. F. J. Ward. He did not sign his name to it, but I recognized his handwriting. I read from this: "A. Transmitter connected to projec-

tion machine—operator's head set to assist in synchronizing." That means the horn attached to the Kinetophone had a transmitter attached to one side. That transmitter was connected to a double head telephone in the moving picture booth. The moving picture operator would wear that telephone while operating the machine, and as he could not hear the phonograph talking through the air, he could hear it through the head telephone.

XQ. 32. As a means to have him synchronize one to the other?

A. To assist him in case it got out of synchronism. Also to notify him that everything was working.

As to how he could help matters if it got out of synchronism, I have seen them bring a picture back into synchronism very quickly. In one way this was a means of preventing the picture and the sound cylinder from getting out of synchronism. There were times when they got out of synchronism. I have seen them out of synchronism. They did not get out of synchronism very frequently. We had no trouble with them in the shows getting out of synchronism. I have taken part in about fifty or seventy-five shows, at which General Carty gave a lecture, and we did not have a failure. That was between 1918 and 1924. Prior to that it was in use at San Francisco and it did not fail once while I was there for a week.

I read the note "B": "B. Amberol roller on which rests rubber show which is connected to disphragm by aluminum rod. This is the amplifying feature." As far as I know that structure was in that machine originally. I have never seen a machine without it. I have no idea when it was put on the machine. The first time I saw the Kinetophone machine was when I went to the Edison laboratory. It had it on there. I will read you item "C": "C. Mica diaphragm clamped between

small rubber rings. Wax record is driven at speed controlled by motor governor." I think that means that a motor driving the phonograph was more or less controlled in its speed by a governor which produces more or less friction. The record on this photograph says: "Wax record driven at speed controlled by motor governor." The man who made this writing understood this machine fairly well. He was my assistant; in other work; not talking picture work. He assisted me once at Washington, D. C., and he was interested enough to get these pictures and make the notes. The object of taking these photographs and making these notes was to put them in the file at the office. I accept these notes, as far as they go, as an historical record of the description and operation of this machine. The Tel. & Tel. Company used this machine to demonstrate between the years 1924 and 1918. I would have to go into our records to find out when the last demonstration was made. As to why we did not use one of the Western Electric sound machines, well, we had this equipment, we were paying for it, it was portable and could be moved, shipped around in trunks, and we were giving our demonstrations at small halls and it fitted in. I don't remember whether the Western Electric Company had any such machine to supply to its parent company up to 1924. I cannot remember whether they had a machine complete in 1924 or not. The Telephone & Telegraph Company was using this old stylus machine for sound reproducing as late as 1924 to demonstrate sound in connection with pictures.

XQ. 58. And so far as you know, is that the best machine they had at that time?

A. Yes, I think it was a very satisfactory machine for that work.

There is a record in the museum at the Bell Laboratories. The Bell Laboratories have one record now

that was used on this machine. The Bell Laboratories are related to the Western Electric Company. The Western Electric Company controls the Bell Laboratories. As to whether it controls the Erpi, Electrical Research Products Company, I am out of the company now and I cannot tell you all of that. I am on the retired list. The record that the Bell Laboratories have is a record of Mr. Watson—the record that the witness here has been testifying about and I have been testifying about. I think that record could be obtained.

MR. WARD: Your Honor, I would like very much—and I think this Court would be interested —to hear that record on this machine. It is in the possession of the Western Electric Company today. The Western Electric Company owns the Bell Laboratories in connection with the American Telephone & Telegraph Company, and I do not think these witnesses' statements are the best evidence of what the machine did when they have the record right in their possession.

MR. ASHTON: I might state, your Honor, that the record is not actually in our control. There is a man at the Bell Laboratories who has charge of all such historical matters. This record has been very carefully preserved, and I believe Mr. Thompson is correct that we can get it, and if Mr. Ward still wants it the first of the week I will make an attempt to get it. I won't be able to do it before then, because the Bell Laboratories are closed. If he still wants it on Monday and tells me, I will do my best to get it. It is in charge of the librarian of the museum.

MR. WARD: I should like very much to have it to check up this thing. I think it is the best evidence.

MR. NEAVE: We will try to get it, Mr. Ward.

THE WITNESS: This license shows that we acquired this machine from Mr. Edison or his people for $500. We paid it all in cash. And the sound and the motion picture part of it.

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HENRY A. TAYLOR, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live in West Orange, New Jersey. I work for the Thomas A. Edison Industries. I am department head of the intermediate machine department in the manufacture of dictating machines, Ediphones. My particular department covers gear cutting, lathe and drill press work, cylindrical and surface grinding, various kinds of bench work, sub-assemblies, and spring manufacturing. I have been connected with Thomas A. Edison, Incorporated, since 1898. I have been with the Edison Company ever since that time, with the exception of two years, 1908 and 1909. I worked in various capacities up until the time I was away from the company in 1908. I worked as toolmaker and foreman of various departments. When I returned to the Edison Company in 1910 I went to work as toolmaker in the Edison Laboratory. I was in the laboratory at the time that work on the Edison Kinetophone was begun. I helped build six Kinetophone recording machines. This tracing is a view of the top plate on the recording machine showing the assembly of the upper part of the recording mechanism, including the gear drive, the clutch arrangement and the balance wheel which is used to give the uniform motion. I got that tracing from

the Edison files. This is the original tracing. I can point out the flywheel on the tracing, right here. This is it.

This is the top plate of the recording machine, showing the upper mechanism of the assembly drawing. It shows the gear arrangement, the clutch and the pulley for balancing the machine, giving uniform motion, the mandrel, the mandrel shaft, the back rod, the feed screw. The motor is not shown in the tracing. The motor is in the cabinet underneath the top plate. This is only the upper part of the machine which you see here.

MR. ASHTON: I offer in evidence the tracing entitled "Assembly Recording Machine, Kinetophone, Edison Laboratory, October 4, 1913."

(Copy of tracing of assembly of recording machine 896, Kinetophone, Edison Laboratory, October 4, 1913, received in evidence and marked Defendants' Exhibit 17.)

The Court has called attention to the name "T. Smith" appearing on the tracing. I knew him. He was one of the draftsmen in the Edison Laboratories. I presume he made this tracing. We had a number of draftsmen. I presume he did, by his name being attached to it. This tracing entitled "Balance Wheel of Kinetophone Recording Machine," drawn by P. Caruse, checked up by T. D. Smith, dated October 1st, 1913, numbered 5/896, Edison Laboratories, Orange, New Jersey, is a tracing of the balance wheel which shows on this drawing, that was used for the recording machine. This tracing I also obtained from the files of the Edison Company. This tracing entitled "Material list for recording machine 896, Edison Laboratory, T. Smith, October 7, 1913, is a tracing of the material list for the part numbers and component parts of a recording machine.

By Mr. Ward:

The Witness: I did not put these items on this list. I do not know who put them on. They were put on previous to building the six recording machines, because these were out in the shop when the machines were built.

By Mr. Ashton:

Mr. Ward: I object to that as leading.

The Witness: I did not use these tracings in making up the recording machines; we used blueprints made from these tracings.

Mr. Ward: How do you know they were made from those tracings?

The Witness: Because they are the same identical parts. It would be hard to say where the blueprints are. We had a lot of trouble digging these up.

Mr. Ward: I object to the testimony, your Honor, of these exhibits, unless the witness can definitely identify them of his personal knowledge as having existed at the dates that he states.

Mr. Ashton: The witness has already testified that he worked from blueprints made from the tracings.

Mr. Ward: I don't think he knows they were made from the tracings.

The Witness: It is a common practice in a manufacturing plant, after you make the tracings, they make blueprints from them and the tracings are preserved, and they do not go out into the factory.

The Court: How do you know that blueprints were made from these tracings?

THE WITNESS: Because I remember the identical parts, such as the balance wheel and the assembly, which I helped machine and assemble.

THE COURT: I will overrule the objection, and exception to the plaintiffs.

MR. ASHTON: I offer the tracing of the balance wheel as Defendants' Exhibit 18, and the tracing of the material list as Defendants' Exhibit 19, and ask that photographs be substituted.

MR. WARD: I have no objection to the substitution of the photographs in the place of the originals, but I do not withdraw my other objection.

(Balance wheel tracing, Kinetophone recording machine, dated October 1, 1913, received in evidence and marked Defendants' Exhibit 18.)

(Material list for recording machine 896, Edison Laboratory, October 7, 1913, received in evidence and marked Defendants' Exhibit 19.)

The recording machine was driven by two large flat spiral springs mounted in spring barrels below the top plate in the cabinet underneath the top plate. These spring motors were standard spring motors of the Edison Company with one or two unimportant differences. The motor was connected with the mandrel by a belt drive from a pulley underneath the top plate, to this pulley in the mechanism above the top plate or pulley on the mandrel shaft. A belt drive was used. It was made of leather. They took great care in selecting the belts. It was very important. As to what function the belt serves besides driving, the belt served to take up any little irregularities that there might be, due to variation in the motor.

One Kinetophone recording machine was built before the six machines which I built. The original machine was built, and from the original machine the

drawings were made up and we built six more. The original machine was identical with the machines which I built. The original machine was used in the Edison studio, motion picture studio in the Bronx, corner of Oliver Avenue and Decatur Place. I know why the six machines were built. They were built to take care of the various studios established here and abroad. To my knowledge there was four machines sent abroad. One went to Japan, one to Russia, one to Germany and one to Austria. As far as I know the others remained in this country. I have not been able to locate any of these seven recording machines, including the original one, up to this time. My belief is that they were destroyed. I recorded records for the Kinetophone on one of these recording machines. I received a special training in the Bronx studio in recording before going abroad. I recorded several talking pictures. Among them was one of Andrew Carnegie who made a speech on "The Duties of the Rich." As to what year I did the recording work, the Carnegie picture was taken, I believe in January, 1914. I used the original machine in making these recordings. It was one that was built before I built the six.

This is a photograph showing the camera and the synchronizer driven by this motor, and was used when making sound records and when recording, driven by this motor. That picture was in my possession before I went to—oh, since 1914. This is a picture which I took to Germany with me. It appears in the picture that the synchronizer is connected to the camera. It is connected by a chain drive by means of sprockets.

Mr. Ashton: I offer the photograph in evidence as Defendants' Exhibit 20.

(A photograph showing camera and synchronizer driven by motor, received in evidence and marked Defendants' Exhibit 20.)

This blueprint shows a picture of the recording machine and the morning glory horn which was used when making sound records. It is elevated, so that the bottom of the horn will be just outside the picture, the horn is raised so as to just be outside the view of the camera lens. Synchronism was obtained between the camera and the recorder by means of a small round belt, which ran from the synchronizer, Exhibit 20 back to a spring balance, so as to keep the belt taut, and then to a pulley on the recording machine.

MR. ASHTON: I offer in evidence the blueprint entitled "Kinetoscope Recording Machine Pedestal" as Defendants' Exhibit 21.

(Received in evidence and marked Defendants' Exhibit 21.)

The recording machine, to which I said the synchronizer was connected by a belt, is the recording machine shown on Exhibit 21. This machine, Defendants' Exhibits 11, is a Kinetophone, used for reproducing talking pictures. This machine is identical with the machines built in the Orange plant prior to the fire of 1914. At that time the Edison plant was practically burned out, and we had a number of machines out in the field at the time of the fire, and this machine must have been one of the machines that came in from the field after the fire. As far as I know it has been until recently at the Edison plant. The Kinetophone reproducing machines were made in the old Edison Phonograph Works, one of the group of buildings of the Edison industries. About five hundred Kinetophones were made by the Edison Company.

The purpose of my trip abroad was to record the master records of the talking machines for the two groups that bought the rights from the Edison Company to make and operate the talking picture records in Germany and Austria. I took a recording machine

abroad with me—one of the six that we built in the laboratory, a Kinetophone, a camera, a synchronizer, and other accessories that go to make a complete apparatus. I made many recordings in Berlin and Vienna; and I made one talking picture in the Vatican in Rome. I remained in Europe from March, 1914, until the latter part of March, 1915.

As to whether the Kinetophone was favorably received in Europe, it was apparent that they were interested, due to the fact that they kept me there while the war progressed for nine months, with the hope that it would be over and that they could continue operations.

I made reproductions, using the Kinetophone in New York City, Philadelphia, Pittsburgh, Erie, Scranton, Rochester, Binghamton, Albany, Gloversville and other eastern cities. I gave these exhibitions in this country for the New York Telephone Company. I showed principally "The Birth of the Telephone," by Doctor Watson. I also ran "College Days" and other talking pictures. For these exhibitions I used the regular Edison outfit consisting of the Kinetophone and the Model D projection machine. The Kinetophone which I used was identical with the Kinetophone which is here, Defendants' Exhibit 11. As to the arrangement I used in these exhibitions, the Kinetophone was placed on the stage in back of the screen and the projection machine was in the projection booth in the rear of the audience and they were connected by a round belt which ran from the mechanical synchronizer on the projection machine to the small grooved pulley on the mandrel of the Kinetophone. I should say I gave about twenty exhibitions for the New York Telephone Company. The last exhibition was in Albany, in April, 1917. We had reservations made to go to Chicago, but war was declared, and all operations were stopped. I gave a few other demonstrations at the

Edison plant in West Orange, to visitors at the plant in 1917 after we came back from Albany.

The purpose of the flywheel on the Kinetophone reproducer Defendants' Exhibit 11, was to obtain uniform speed. The same is true of the flywheel on the recording machine.

The dimensions of the flywheel of the recorder appear from the blueprints. As I remember, they are four and three-quarters inches diameter by three-quarters of an inch wide. The flywheels on the Edison recorders and reproducers were absolutely accurately balanced when the machines were made. As to whether it would or would not be possible to get the flywheel on either the recorder or reproducer out of balance if the machine were given a sudden shock or a blow, I have seen Kinetophones come in off the road with shafts bent and all kinds of—well, I called it junk, put on machines by people who didn't know what they were doing. In my opinion the shaft on this machine, Defendants' Exhibit 11 is bent. I came to that conclusion when I saw that machine last evening rotating and the flywheel running out. In my opinion, that shaft is bent from the outside of the casting, probably caused by the flywheel having been given a blow. I could not state right now if the flywheel is accurately balanced. The flywheel could be put back in balance if it were out of balance by means of a piece of lead. I have seen it done. But if I had to balance a machine in the plant, though, like that, I would take the pulley off and straighten the shaft and reassemble it. As to how I would do it if I did not want to take the machine apart, well, if it was out in the field and did not have any other way of doing it, I might attach a piece of lead on the pulley which I see on that machine.

I have not examined the synchronizer on the Kinetoscope, Exhibit No. 12.

(Witness examines the exhibit.)

This synchronizer was made by the Edison Company. No more than one type was made. This photograph correctly illustrates the synchronizer.

MR. ASHTON: I offer this photograph in evidence as Defendants' Exhibit No. 22.

(Photograph representing synchronizer of Kinetoscope received in evidence and marked Defendants' Exhibit 22.)

The Edison Company commenced to build synchronizers in 1912. They were made in the old phonograph works. They built them up until the time of the fire in 1914. I could not say when this synchronizer was made. There was a number of them built. I cannot say whether it was one of the first series or the last. It was made before the fire.

This is a letter that I received from the chief engineer and personal representative of Thomas A. Edison while I was in Vienna. It is relating to the fire, and I received it right after the fire, telling me the damage that was done, and that they had stopped manufacturing Kinetophones for the time being. According to the letter, the Kinetophone studio was intact. Mr. Hutchinson, the chief engineer and representative of Thomas A. Edison, states that they have stopped manufacturing Kinetophones, due to the fire, and they expect to take them up later on.

MR. ASHTON: I offer the letter in evidence as Defendants' Exhibit 23.

(Received in evidence and marked Defendants' Exhibit 23.)

This is a copy of the letter that was written in German by the Imperial Counsel, Arthur Kola, to the direction of the Imperial Royal Police of Vienna, who was one of the group of the German concern who pur-

chased the rights to make and produce talking pictures in Germany, and the object of the letter was to have the police sanction my leaving Vienna. It tells how I went abroad without taking passports with me, not anticipating the great war, and this letter would have carried me through, but the day I received this letter we got in touch with Washington and my passports were granted, so I came back on an American passport.

MR. ASHTON: I offer the letter last referred by the witness, dated March 2d, 1915, in evidence as Defendants' Exhibit 24, and I ask that copies may be substituted for both letters.

(Received in evidence and marked Defendants' Exhibit 24.)

Q. 98. I show you a cylindrical phonographic record and ask you to state by whom it was made.

A. This is a talking picture record made by the Edison Company of Orange. All I can say is that it was made prior to the fire in 1914. The subject appears on the edge of the record. It is "The Birth of the Telephone" by Thomas A. Watson. I have examined it last evening and it is in very poor condition.

MR. ASHTON: I ask that the record be marked for identification as Defendants' Exhibit for identification 25.

(Cylindrical record, "The Birth of the Telephone by Thomas A. Watson," marked Defendants' Exhibit 25 for identification.)

The record has apparently been run more than its intended life, and I should say that the walls of the track are worn down, so that you will not get a good reproduction, and you will get a lot of surface noise. It is also warped due to the age. It is badly warped. I should say from what I saw of the machine that these records were never intended to last for twenty-five

years. I have had considerable to do with phonograph records at the Edison Company back as far as 1898 and 1899, when I was foreman of the department which duplicated the small cylinder records from the master record, for the home machines and so forth. It would be difficult to determine very accurately how many times this record has been played, but I am positive that that record has run at least 500 times or more. The life of these records is not supposed to be more than about 300 demonstrations. Even at that, on some selections the records will so wear down that a new record should be used in its place.

This other record was also made by the Edison Company of Orange. The title is "The Edison Minstrels." I have examined this record to determine its condition. I examined it last evening and I should say the record is in fairly good condition. It appears to me that record has not been demonstrated more than a few times. I reach that conclusion by the surface noise. It is very good. I don't know when this record was made, except that it was made prior to the fire.

MR. ASHTON: I ask that this record, entitled "The Edison Minstrels," be marked for idenfification as Defendants' Exhibit for identification 26.

(Marked Defendants' Exhibit 26 for identification.)

This is a piece of a film that was made in the Vatican, Rome. It demonstrates how the synchronizing point is established on the record and film. The record was made by myself. Those records were left in Germany. The film, the film was in my trunk, packed away for about eighteen years. In fact, I didn't know until yesterday morning, when I was home looking through my possessions, that I had it. I had forgotten all about it.

This film shows how an operator with two pieces of cocoanuts stands just inside of the picture and, when the signal is given to start the machine, he comes down and gives them a knock together, and that makes indentations on the record which gives you that same knock, and that allows him to establish the starting point on the record with the film. The point on the film is where the two cocoanut shells come together. That is cut off the film and the title and twelve pictures—twelve plain pieces of film are in between the title and the pictures, establishes the point at which the operator starts the phonograph. That is a positive. I recorded the talking picture at the Vatican some time in June, 1914.

MR. ASHTON: I ask that the two pieces of film be marked in evidence as Defendants' Exhibit No. 27.

(Received in evidence and marked Defendants' Exhibit 27.)

CROSS-EXAMINATION.

By MR. WARD:

I have given some opinion evidence as to the condition of these two phonogram cylinder records, Defendants' Exhibits 25 and 26. As to what experience I had with regard to observing the approximate wear and tear on this type of record, rather than the hard rubber disc type that I have been working on since, I am familiar or accustomed to observing these records with a microscopic inspection. In fact, we never make a record—never record a record without first ascertaining the depth of the cut of the stylus, before proceeding to make the original record. I have also observed a life test which is given to these records, at fifty plays, and 75, 100, up to 300. This is not a wax record. Defendants' Exhibits 25 and 26 are both moulded records.

They are not the originals. We make an original record and from that original record we make a mould. And then we make several; quite a number. I had experience in testing and observing the life of these moulded records, such as Defendants' Exhibits 25 and 26 and I say that I think that Defendants' Exhibit 25, the Watson record, has run beyond its useful life, and it is my impression that Defendants' Exhibit 26 has only been run a few times. That is my opinion from the examination of them. In Exhibit 25 you have a lot of surface noise, scratches, which would indicate that the record had been run a number of times. From my experience, the more a record runs, the rougher becomes the surface. And the surface on the Watson record is very rough. In fact, a record like that, at the time we was in the talking picture game, would have been discarded long, long ago. And then again, I noticed when we put that on the cylinder, that it is in a very warped condition; and I presume you could expect that after about eighteen years.

I said that it had surface noises. The first time that I heard that record was last evening. I heard the Watson record played last evening. I heard the Defendants' Exhibit 26 played last evening. On what I saw and heard last night is what I base my opinion that the one was not in good condition and the other was in good condition. I do not base my opinion as to the life of the Watson record on what I heard last night; I didn t base my opinion as to the life. I knew that twenty years ago. After hearing it I determined that it had been run far beyond its life of intended usefulness. And I determined that by what I heard, the results of the playing of the record. My determination as to the extent of use of the Defendants' Exhibit 26, the "Edison Minstrels," was based on the fact that the surface noise was very good; which indicated to me, from my experience, that the stylus,

the reproducing ball, had not been run over that surface but very few times.

At the time that the first or original Kinetophone was built I was a toolmaker in the laboratory. I had nothing whatsoever to do with the building of the so-called original or first Kinetophone machine. In 1912 we started to build the six machines from those drawings, and I was assigned to the job to help build those six machines. The first time I saw the original machine was when I went to the Bronx studio in 1913. In the fall of 1913 I examined it. I understood its construction. I operated it. I took part in the building of these additional six machines later on.

I can describe the construction of the first machine so far as concerns tracing the application of the motive power through the gearing or belts to the cylinder. From the spring motor under the top plate they run to a pulley with belt drive to a pulley on the mandrel shaft. By the mandrel shaft I mean the shaft which carries the mandrel and the cylinder, the cylinder and its record. The synchronizer pulley and the balance wheel are on the shaft, and when the motor starts they are continuously running. On the same shaft is a clutch which, at the action of a clutch lever, engages the clutch onto the shaft which carries the mandrel shaft gear which, through an intermediate gear, transmits its motion to a gear on the feed screw. The feed screw is connected with the back rod by means of a feed nut spring and feed nut which meshes into the feed screw, and there is an overhang arm from the back rod which runs on the straight edge——

XQ. 156. You need not go into the feed screw unless you want to continue. I asked you about the gearings of the motor up to the mandrel.

A. Yes, sir.

I said that a belt came from the spring motor up to a pulley on the mandrel shaft. That is correct. And I

said that the balance wheel was on that same shaft. And another pulley, synchronizer pulley; the idea of that was that that would be in motion all the time, so that when the clutch was thrown the cylinder would immediately pick up at the speed of the shaft that the flywheel was on. The object of the synchronizer pulley being on the same shaft that the balance wheel was on, so there would be no lag or hesitation when the clutch was thrown in. It would be in motion with the synchronizing pulley on the Kinetophone. That is, you wanted the mandrel shaft with the balance wheel on it, rotating at the full speed, so that when you threw in your synchronizing with that shaft from the pulley, the synchronizer would immediately respond with these parts at normal speed.

These hollow sleeves do not always fit properly on your mandrel.

XQ. 164. What means did you have to overcome that trouble?

A. What little they were out of true is so imperceptible when playing a talking record that we did not do anything.

We did not have to do anything about it. We got good records as they was. The machines were in balance. As to what I think would have happened with respect to changing the quality, if you put these cylinders on with the kind of fit we got and took off the balance wheel, if you took off the balance wheel it would not be any good. The results would be so poor. When you engage your clutch it would just lag and draw, and you would not get anything until you had gotten all the way across the record. You would not get any regulation.

XQ. 167. The balance wheel was quite important there to assure that you got your synchronism properly?

A. It was very important to see that you got uniform speed.

XQ. 168. To get your synchronism properly?

A. The main object was uniform speed.

XQ. 169. Suppose your speed was not uniform. Suppose your machine varied a few revolutions per minute or per second, but you had your balance wheel, as you call it, to make your synchronizing device pick up properly—promptly. What harm would that do?

A. Our machines were always checked for uniform speed——

XQ. 171. What harm would the few variations do?

A. Variations in the speed per second?

XQ. 172. Yes.

A. You would get an irregular sound. You would have no regulation on your record. Your record would sound all out of regulation. If it was a musical record the pitch would go up and down.

XQ. 173. What effect, if anything, will the two or three revolutions per second variation have on your clutching into your synchronizing, in synchronizing your picture? That is what I am trying to get at immediately.

A. Two or three revolutions would mean about two and a half per cent. of the revolutions of the spindle, which is 120.

XQ. 174. I mean with respect to putting in the clutch. You understand that, don't you?

A. I cannot just see what you are driving at there. Your question is not clear to me.

The mandrel on the recorder makes 120 revolutions per minute.

The difference between the first machine and the six machines was this: that in building the first machines it was experimental to a certain extent and, instead of having castings made, it was built up—which is common practice in building the first model of almost

anything. When we established what we wanted, castings were made for several parts. That is to facilitate manufacture. The differences between the last six and the first were as I have just stated. We built up certain parts instead of having castings, and when we decided that the first machine was all right, instead of putting up and soldering two pieces together or screwing them together, we had castings made. We did not change the arrangement of the gears as shown on this drawing; practically the same as near as I can remember. I don't remember any change. I testified that the last six machines were like the original, with the exception of certain definite changes. The main construction was practically the same in every way, except that we used castings instead of built-up parts. The clutch was not different; not to my knowledge. I know. I helped build the last six machines, and I knew them, yes. I saw the first machine, the built-up one. As near as I can remember, the clutch was the same. I don't think the clutch was more like the reproducer here in evidence.

This Exhibit 17, and this print of the balance wheel, Defendants' Exhibit 18, are not the only drawings that I was able to find to show the construction of this first machine. In going through the files of the Edison plant I came across the envelope containing—I didn't examine it to see if they were all there, but I presume all the detailed drawings are in there. But Mr. Thompson of the Western Electric Company seemed to be more interested in getting these drawings. And in fact those are the drawings that he asked for, and they were sent over by the Edison Company. Mr. Thompson is the gentleman who testified here. On this material list that has been put in evidence, Exhibit 19, there are a very large number of drawings listed. Exhibit No. 17 has been taken off the material list.

Mandrel shaft bushing. Scratched out. You asked me about the large assembly view, A-896. I find that as the second item. And then the drawing, Exhibit No. 18, 5896, I find that right here, balance wheel.

As to what has been struck off that I referred to in this they call for lead and cast brass. But there was a steel bushing in this casting. There was a bushing in that casting. Exhibit No. 18. And that probably is the bushing referred to there. I haven't got here the additional drawings of this machine indicated on Exhibit 17. There was a lot of drawings in the files. I don't know just what they were. I cannot say how many. There was a number of drawings in the files.

XQ. 202. Now, according to my eyes here the copy of this assembly tracing I have indicates that there have been some alterations and erasures down here in the lower left-hand corner. Do you know anything about that?

A. It seems more of a blur on this photo. It does not seem to show up—it seems to be more of a blur on the copy than on the original.

I don't think what appear to be erasures on the copy occur on the original.

With regard to the putting of these hollow cylindrical records on the mandrel, there will be no appreciable difficulty up to a point in recording or in reproducing if there happens to be some slight eccentricity which brings about the lack of balance by a relative misfit of the record cylinder on the mandrel. If it was only slightly—and that is the condition which we had—it would be so slight that it would not be perceptible. Of course, if you had a record, whether it was recording or reproducing, if you had a record and you was recording and it ran out so much, why, you would get a deep cut on one side of the record and a shallow cut on the other, and that would have an eccentric sound,

chiz-z-p, chiz-z-p, chiz-z-p. A small lack of balance on those records would be barely noticeable. The quality of recording and reproducing on those machines was not coarse. As to why you wouldn't notice the lack of balance, well, the recorders and reproducers are so mounted that they will follow that up and down, that eccentricity, where it is so slight. The stylus would follow it and so would the reproducing diamond point. As to what that lack of balance would have to do with a tendency to change the uniformity of speed of the shaft, the balance wheel takes care of that and keeps the mandrel in uniform speed.

XQ. 212. That is all right, but will you answer my question: if you had the lack of balance in the mandrel and did not have the flywheel on, what would the lack of balance in the mandrel have to do with the quality of your recording or reproducing?

A. There would be no regulation. And the lack of balance would tend to affect the uniformity of speed.

I was familiar with this machine, this Kinetoscope machine, Exhibit 11, a good many years ago.

XQ. 215. Do you know how that flywheel or pulley, or whatever you want to call it—or have called it—is attached to the shaft that runs through it?

A. Yes, sir. That flywheel is keyed to this shaft. Keyed to the shaft carrying the mandrel. So that the mandrel shaft slides through it. I am sure about that. Positive about it.

Mr. Ward: Mr. Haselton, will you get a hold of this thing and turn it for me there.

XQ. 220. Do you observe that the——

A. The clutch is——

XQ. 221. One minute. Just one minute.

A. The clutch is keyed. The balance wheel is run into the——

XQ. 222. Mr. Taylor. Mr. Taylor.

MR. WARD: Will the Court——

THE WITNESS: Well, excuse me for overlooking that.

XQ. 223. Mr. Taylor, I want to get a direct answer to the question. That is all I want, to the question on the record. Did you observe, when Mr. Haselton held the shaft to which you said the pulley or flywheel was keyed, that he was able to turn the flywheel without the shaft turning? Now, do what you want to.

A. Now, will you excuse me——

XQ. 224. No. Please answer first and then give your explanation. Did you observe? This has got to appear on the record.

A. Yes, sir.

XQ. 225. Did you observe that when the shaft to which you said that the flywheel was keyed was held rigidly on the mandrel, that it was possible to turn the flywheel on that shaft? Did you observe that?

A. No. But it came to my mind that we could not —this machine couldn't—as I have explained to you—if the balance wheel was keyed to the shaft.

MR. WARD: I move that the answer be stricken out, and let the witness answer the very simple question I have put to him, as to whether he observed when that shaft was held from rotation, that the flywheel could be rotated on it.

XQ. 226. Did you observe that?

A. I did not.

MR. WARD: Mr. Haselton, will you please hold that shaft again?

XQ. 227. Now, is the shaft being held rigid by Mr. Haselton and the mandrel?

A. The shaft is held rigid and the mandrel, and he is rotating the balance wheel.

XQ. 228. All right. Now, go ahead and give any explanation you want of it.

A. I haven't seen this machine for years and you asked me the construction of it. I said that the balance wheel was keyed to the mandrel shaft. What I intended to say was that the driving clutch was keyed to the mandrel shaft. And when you threw in the clutch you engaged the balance wheel and the synchronizer pulley with the clutch on the mandrel shaft.

The pulley is fastened to a bushing which goes through this housing, and that revolves. On one side of the bushing is fastened the balance wheel. On the other side of the casting is fastened the clutch which engaged with the clutch which is keyed to the mandrel shaft. Do you get it?

XQ. 230. I ask you to look at the shaft, as Mr. Haselton is holding it there, and see if both members of the clutch are not stationary at times while the flywheel or pulley is still being rotated. I will ask you to look at that construction closely and see if there is not some different connection from what you thought between that pulley and even the clutch sleeve on which you thought the flywheel was rigidly secured.

A. It is not rigidly secured. It is held by two springs on to a sleeve on which one member of the clutch is secured. I can tell you why that pulley is connected by springs to that clutch member. That is to allow for any little variation in speed. It allows it to pick itself up. I don't mean that the spring connection between the pulley and the clutch sleeve permits relative movements, rotative movements, or angular movements, between the mandrel carrying the sound record and the pulley. That works out just as I said. It allows for any little slips, that allows it to slip and pick up.

XQ. 237. Allows what to pick up and slip with respect to that which is not supposed to slip?

A. The mandrel. It allows for slip between the pulley or flywheel and the mandrel. That spring is between the pulley and the mandrel. It does not permit variations of angular movement or speed between the pulley and the mandrel.

XQ. 241. Why doesn't it? Didn't you say it was for the purpose of taking care of little irregularities?

A. Yes, but not that. This must travel the same as that. The function of the spring is to keep this pulley—that keeps that up against that part there.

XQ. 243. Where does it have any function in taking up little irregularities if it does not take them out between the pulley and the mandrel?

A. It helps to take them up; it helps to take up any little irregularity with the motor. Only by taking them up between the flywheel and the mandrel. I never saw a sound on film sound picture machine. Don't know a thing about them. I have not been connected with the motion picture business since 1917. I don't even know the principal on which the sound on film sound picture machines function or operate. In 1917 I was assigned to my present position, which has to do with the production work in the factory.

XQ. 248. Do you know whether in the recording machine the flywheel was connected, as you find it connected in that Kinetoscope, Exhibit 11, to its shaft?

MR. NEAVE: What recording machine?

XQ. 249. The recording machine of Exhibit 17, or the six that you built. I would rather have you answer without looking at that drawing there.

A. I will try to. The flywheel was not keyed to the mandrel shaft, as near as I can remember. It would be secured to the mandrel shaft on the sleeve. As near as I remember, the flywheel was on a sleeve, and the mandrel shaft went through the sleeve.

XQ. 253. Well, you are testifying about the construction.

A. We have it on the drawing there.

XQ. 254.You did not make the drawing?

A. I did not make the drawing, no. The only way I am able to identify the drawings is that I found them in the files and I had blueprints made from them.

XQ. 256. I should think you should have to identify them by what you remember of the structure. You cannot say that the blueprints are like the drawings unless you remember the structure which you made from the blueprints.

A. It has just come to my mind. The balance wheel was not bolted to the mandrel shaft. It was connected, as I remember, on a sleeve, and the shaft ran through a sleeve. The balance wheel ran independent of the mandrel gear, intermediate gear, and the feed screw gear. As to how the balance wheel applied any control to the mandrel it became connected when the clutch was engaged. As near as I can remember the balance wheel was connected on the clutch sleeve and the other member of the clutch was connected to the mandrel shaft. It is a good many years since I handled that job, and I cannot remember every detail twenty years back.

XQ. 262. It is rather important, Mr. Taylor, in connection with these machines, to determine how the flywheel was related to the mandrel.

A. You have the drawings there.

XQ. 263. Yes. But you are the only witness that is identifying these drawings, and I want to see what you remember about it.

A. Well, I cannot remember every detail of the drawings. I believe I remember the construction that I have given here in the last six or ten questions as being the correct construction of the Edison recorder,

the original and the six models. That is, so far as my description goes, that is the correct construction.

I have made reference to a very careful selection of the belts connecting the spring motor with the pulley on the recording machine and I said that that, again, was to take out the "little irregularities."

XQ. 269. Where did you get this expression, "little irregularities," which you seem to be using so much in your testimony?

A. It is a common expression, a common term in the phonograph game.

XQ. 270. No one showed you this expression in the patent in suit?

A. I have heard those expressions for the last thirty years. I have not read the patent in suit.

XQ. 272. Nobody told you about it?

A. I really don't know what I am here for except to answer some questions in regard to the Kinetophone.

XQ. 273. Can you tell me just what treatment the belt was given to take out these little irregularities that you refer to?

A. What treatment the belt was given?

XQ. 274. Yes. You said it was specially treated or selected.

A. Yes. I said they were leather belts. They were calves' leather belts. And the belts were stretched before they are cut to length and cemented together, and then after that they have another stretching process which they go through. That is done mainly because each belt is stitched around on each side in a sewing machine, and that is to get all of the stretch out of it, so that the thread will not have to carry the load. That is to say, you stretch those leather belts so as to get practically all of its elasticity out of it so that the threads with which the belts are stitched will not have to carry the load. In other words, to bring the leather,

which has a certain inherent elasticity before treatment, to get that out to an extent where it would have practically the same elasticity as your threads. And of course, another object is so that we can get these machines out on the road and the leather would get that treatment or they would stretch and soon become loose.

XQ. 278. In other words, you want to get that stretched as much as their use would get them stretched on the road?

A. I am not a leather expert, but from what I can observe of their operations in the plant, that is what they are doing. What we would call pre-shrunk in textiles, or pre-stretched in leather. I did not say they were given that treatment to take out these little irregularities. I said that the term "little irregularities" was used in the plant.

XQ. 281. I think you are right. The question was this: "What function did the belt serve besides driving, if any?"

> "A. The belt served to take up any irregularities that there might be, due to variations in the motor."
>
> And just ahead of that you were asked:
>
> "Was any care exercised in selecting these belts?"
>
> "A. They took great care in selecting the belts. It was very important."

A. Yes, sir. I did not mean to testify by those two answers that the belts had any special treatment to take out irregularities. They had no relation to each other.

I said I gave myself some demonstrations with the Edison pictures. No admission fee was charged for those. I understand it was just an educational stunt for the telephone employees. In recording our sound and pictures, the picture was taken synchro-

nously with the sound. Both taken together, simultaneously.

Reference was made by me to the fact that when these machines were used in theatres for reproduction, that the picture machine was at the rear of the theatre. And the Kinetophone was behind the screen. And that the auditoriums were as much as approximately thirty to thirty-five or forty feet from the rear to the front, from the screen to the machine. As to how the two machines were coupled together, there was a small round belt run from this pulley, the synchronizer pulley, up over a series of pulleys, up along the ceiling, and down to this pulley on the synchronizer.

That is, from the pulley to the left of the main driving pulley, as you face Exhibit 11, on the side in which the stylus diaphragm is located, and a belt went up to the ceiling, over a series of pulleys that travelled back, across the length of the theater and back to the synchronizing device. As to how many feet of belting would that amount to, that would depend upon the depth of the theater. I testified that a thirty-foot span was one of the dimensions. I have run a belt in the opera house in Philadelphia, and we had a throw there of 210 feet. The belt there would be twice 210 plus the up and down on either end. This was a flexible belt.

I said that this Defendants' Exhibit 11 seemed to have had a blow which knocked it out of skew, made the shaft somewhat out of alignment. I do not see any indications of it having received any such blow, but that don't have to be necessary; it is not necessary. You could have a blow without showing it, if it was hit with a piece of wood or something that would not mark.

I testified about the synchronizing of these two machines (Defendants' Exhibits 11 and 12) and the

fact that one was driven by a crank. If the operator cranking the motion picture machine did not crank it fast enough you would not get any synchronism. In cranking that machine you have got to keep it up against the brake on the synchronizer. And that machine is cranked at the rate of, I think it is, sixty revolutions per minute.

XQ. 303. That is, if the man who is cranking the machine, as long as he cranked it up to or beyond a certain speed, it worked as it was intended to work, so far as the synchronizer could make it synchronized; but if he dropped below that critical speed they would no longer be any synchronism?

A. There would no longer be any synchronism; no, sir.

XQ. 304. Then what would happen?

A. Then your picture would be out of synchronism.

XQ. 305. The whole show would be over, until an adjustment was made?

A. The whole show would be over. But that is something that is practically an impossibility, because a man cranks that machine just as far as he can, he keeps up against the brake, he can't go too fast.

There was some minor difference between the standard Edison spring motor and the spring motor which was on these recording machines. I know the pawl and the ratchet were different, because I made them myself. And we carried a double, what we called a double pawl on there; whereas the original motor only had a single tooth in the pawl. A characteristic of the spring motor after it runs down to a certain point is that you do not get regulation. That is the reason we carry two springs in that barrel, so as to be sure it will keep its regulation the entire length of time that we are recording. That is, you had long enough springs so as to maintain the uniform speed

while the recording was going on. The records played on this machine for six minutes. Of course, you could have a show with seven or eight records. That is, there was four hundred feet of film to six minutes of record time.

There was some literature on the Kinetophone. I do not know if there is any in existence today or not. I haven't got one. I have not seen any in going through the records and, as I say, I haven't seen. This stuff is all eighteen years or more old to me. It was difficult for me to dig up and recall the information which I have given you.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

On Defendants' Exhibit 19 the assembly drawing, Exhibit No. 17, is listed as A-896. The assembly drawing to which I referred is the second one on the list of Defendants' Exhibit No. 19. The other drawing listed as sub-assem is the sub-assembly of this. A sub-assembly drawing is a part of the machine with not the full assembly. I am not positive, but I believe we could produce here in Scranton all the drawings on this list Defendants' Exhibit 19. I was not asked to bring them here.

During my cross-examination with respect to the recording machines which I made and which are illustrated on the drawing Defendants' Exhibit 17, I did not have the drawing Defendants' Exhibit 17 before me while I was testifying.

RDQ. 326. Will you kindly look at the original tracing of Exhibit 17 and state what the construction is with respect to the mounting of the flywheel, the clutch and the motor-drive?

MR. WARD: Your Honor, I object. The witness was not able to state on his direct that he

either made that sketch or had anything to do with the making of it. He said he saw some blueprints that were made from it.

MR. ASHTON: He had blueprints here.

MR. WARD: Let me finish, Mr. Ashton. And the way he knew he had blueprints from it was that he was familiar with the machine and had built one. Now, I examined the witness without letting him see those drawings, and he described that machine quite differently from the way these drawings show. And he said that that was his recollection of the way the machine was constructed as he built it and used it. And that description, given by the witness, is distinctly contrary to what these drawings seem to show so far as they show anything.

MR. ASHTON: I do not know if that is so, your Honor.

MR. WARD: I do not think that is right; I do not think Mr. Ashton should be permitted now to have his witness contradict his testimony by going back to the drawings and saying that he sees now that those drawings show something else.

I think the cross-examination shows the witness is not qualified to identify the drawings.

THE COURT: Well, if the witness should contradict himself that will be a matter for the Court to consider. And his credibility is for the Court to consider. I think I will overrule the objection and let the witness testify.

MR. WARD: All right.

THE WITNESS: What is the question, Mr. Ashton?

MR. ASHTON: Will you read the question.

(Question read by the stenographer.)

MR. ASHTON: I would like to add to the question:

RDQ. 326a. If you are able to tell from the tracing.

MR. WARD: Are you asking him what the tracing shows?

MR. ASHTON: If he knows by looking at the tracing.

MR. WARD: What the tracing shows, or what the construction was that he has testified to?

MR. ASHTON: I asked him to look at the tracing and determine what the construction is, if the tracing shows.

MR. WARD: Well, your Honor, I think Mr. Ashton should state whether he is asking the witness to look at the tracing to see what construction the tracing shows, or whether he is asking the witness to look at the tracing and see what construction the machine as actually made was.

MR. ASHTON: State first what the tracing shows. I do not know whether there was any difference or not.

A. The tracing shows that the balance wheel was keyed to the mandrel shaft, and at the time I gave the testimony I was under a different impression. I had a different view of the machine.

RDQ. 327. Previous to your testimony had you been asked by anyone to determine whether or not the balance wheel was keyed to the mandrel shaft?

A. No, sir.

RDQ. 330. I show you Defendants' Exhibit No. 18 and ask you if there is anything shown in that ex-

hibit as to whether the flywheel was or was not keyed to the mandrel shaft?

A. The set screw, the five thirty-seconds, the fifty tapped hole shows there that it was keyed to the shaft.

RDQ. 331. Do these drawings, Defendants' Exhibits 17 and 18, or do they not, refresh your recollection as to the construction of the six machines which you built?

MR. WARD: I object to that question, your Honor. The witness did not make the drawings, he has testified.

MR. ASHTON: He has testified that he worked from them, your Honor. And I asked him now if they refreshed his recollection.

THE COURT: He testifies that he understands the drawings, he explains the drawings, worked from them. Now what is the question?

MR. ASHTON: I asked him if they refresh his recollection as to the construction of the machines.

THE COURT: I will allow the question; exception for the plaintiffs.

MR. WARD: I would just like to correct Mr. Ashton. He did not say he worked from these drawings at all. A blueprint of some kind.

THE COURT: Well, blueprint from these drawings.

MR. ASHTON: That is what he testified; that is correct, your Honor.

However, we will ask it over, in view of the fact that Mr. Ward has raised the question.

THE WITNESS: I testified that I worked from blueprints in making the six recording machines. The blueprints were made from the tracings which I have been referring to here. Therefore they were identical.

I had not discussed with anyone before I testified here this morning whether or not the flywheel on this machine was keyed to the shaft in Defendants' Exhibit 11.

I testified on cross-examination that I had never been shown the patent in suit. I was able to keep the sound and pictures in synchronism when I operated the Kinetophone. I always had good success.

RE-CROSS-EXAMINATION.

By MR. WARD:

I testified in answer to your questions that I first saw the original machine some time after it was built and used. That is, the first original Edison Kinetoscope machine. The first time I saw that was in the Bronx studio. I never saw it before. I never saw it being built.

RXQ. 342. Then you do not know what blueprints it was built from; that is to say, you do not know whether the blueprints it was built from were blueprints taken from this tracing, Exhibit No. 17, do you?

A. Yes, sir; I know those copies were made from the original machine.

I personally know that because I was personally acquainted with the technical man on that job, and conversation with him, and from examining the machine, as far as I could see it was identical with the machine that was built afterwards. I asked questions why we were building the six machines, and everything was the same as far as I could find out on the original machine.

RXQ. 345. I am asking you about the original machine; not the six. How do you know that the blueprints that were made from the tracing that you say was made from the original machine were blueprints made from that tracing?

A. Because I worked on the original machine, and this was all fresh in my memory. I just come out of

the tooling room, helping to build the six recording machines. I did not see the blueprints made. I did not see them run through the blueprint machine.

RXQ. 347. All you know is that you had some blueprints that you made the six machines from?

A. Yes, sir; and they were identical. That is my belief today, my recollection. I did not take the blueprints and compare them with this tracing, Exhibit 17.

RXQ. 350. And your recollection of the actual machine which you built with your own hands and which you say you operated several times, certainly ought to be as vivid in your mind or as reliable as your recollection of a blueprint that you had?

A. As recollections will go after about twenty years. I had nothing whatever to do with the listing of those parts on this material list. That was picked out of the Edison files the other day. I did not even spend any time to examine it. I just went by the name on the top. Those were our records. I had nothing to do with keeping those records.

RXQ. 355. After looking at this drawing Exhibit 17 and being asked to look at Exhibit 18 showing the flywheel, you said that on these drawings the flywheel or balance wheel, or whatever you call it, was keyed to the mandrel shaft?

A. Yes, sir.

RXQ. 356. I ask you to look at the hub of the balance wheel.

A. Yes, sir.

RXQ. 357. As shown on Exhibit 18, and then look down on the lower figure of Exhibit 17, and see if you do not see a difference between the lengths of the hubs of the balance wheel on Exhibit 17——

A. And the length of the hub on the balance wheel here?

RXQ. 358. The length of the hub of the balance wheel.

A. One inch. Is that what you are referring to?

RXQ. 359. Yes.

A. Yes, sir.

I see with respect to the shaft on the lower part of Exhibit 17 that the flywheel is on the mandrel shaft. It appears from this drawing, Exhibit 17, that the balance wheel or flywheel and the pulley are on a sleeve surrounding the mandrel shaft, as I testified in answer to your questions, as I recalled the construction to be. My statement about the flywheel being on a sleeve surrounding the mandrel shaft, which is not keyed, is correct.

RXQ. 363. Mr. Taylor, will you take this glass for a minute? I just want to get your opinion on this point. On the upper left-hand part of this original tracing, of which Exhibit 17 is a substitution, do you find any different character with respect to the line running transversely of the sleeve, which is immediately adjacent to the line outlining the periphery of the balance wheel? Do you find any difference in characteristic of that line with respect to the other lines along there? The line I am directing your attention to being about one-sixteenth of an inch to the left of the flywheel.

A. Yes, that is the end of the hub on the detail drawing.

RXQ. 365. Does the line look any sharper or blacker with respect to any of the other lines around there?

A. I cannot say it is any sharper than the line on the side of the balance wheel or the other lines.

It looks to me that they compare favorably with the dimensions on the detail which shows that the hub is one inch long and the pulley three-quarters of an inch wide. You have three-sixteenths up on one side and one-sixteenth on the other side, which accounts for the four-sixteenths difference between the width of the

pulley and the length of the hub. I said that the term "sub-assembly" on the first line of this material list means a part assembly. It does not mean a substitute assembly. It means a part assembly. The very first item under the word "name" on Exhibit 17 is sub-assembly B-896. That means part assembly. The A-896 is a complete assembly, and the sub-assembly B-896 is a part assembly, which I presume you will find that drawing gives further. That is a customary expression, "sub-assembly." Sub-assembly drawing. We always use the term "sub-assembly" to mean part assembly. If we substitute another assembly drawing for an original drawing, it would be a substitute.

By Mr. Ashton:

I referred to the sleeve in the upper part of Exhibit 17. I said that that sleeve is also shown on the tracing of the balance wheel Exhibit 18. The flywheel is mounted on this mandrel shaft by means of a screw. There is the screw hole. As I see it now, it is locked to the shaft through that screw. That sleeve or hub is shown in the lower part of the lower view on Exhibit 17. It does not appear to show it on the bottom here as it does on the top. There is a line that is not on the bottom view that is on the top.

RDQ. 385. Do you know whether the six machines which you built were built in accordance with the two exhibits to which you are referring, Nos. 18 and 17?

Mr. Ward: I object to that, if your Honor please.

The Court: Overruled.

A. I believe that they were identical, as I said before.

I could get the rest of the drawings referred to on the material list from West Orange, I think, and

have them here tomorrow. I will do that after I leave here. Of course, it is up to the Edison Company, but I don't think there will be any objection.

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WILLIAM C. BALLARD, JR., having been previously duly sworn, resumed the stand for cross-examination:

CROSS-EXAMINATION.

By MR. NEAVE:

XQ. 181. Mr. Ballard, a flywheel is sometimes called a balance wheel, isn't it?

A. I don't think that the terms are synonymous, Mr. Neave. A balance wheel, as usually applied, refers to a device which has restricted motion. You hear the balance wheel frequently spoken of in watches and clocks. The terms are not synonymous, to my mind.

XQ. 182. I have seen some books in which they were stated as synonymous, but I will look those up and bring them to you. Now I want to inquire a bit into the flywheel effect that we have been speaking of. Let us assume first that we have a shaft mounted so as to be capable of being revolved, the shaft having a flywheel on it; then assume further that we in some way connected with the shaft, some means for revolving it, such as an electric motor, for instance. Assume that we then start the electric motor to start the shaft in revolution and to bring it up to a speed of say a thousand revolutions a minute. It is true, is it not, that while the shaft is accelerating and coming up to that speed, the thousand revolutions per minute, the flywheel opposes that acceleration by reason of the inertia of the mass of the flywheel, and that that opposing force is absorbed by the flywheel and there stored up as kinetic energy?

A. I do not agree with that statement, Mr. Neave. I do not see how the flywheel can exert the opposing force and absorb it at the same time.

XQ. 183. You are starting with a shaft in rotation, the shaft having a flywheel on it. Does the flywheel oppose the starting of the revolution?

A. The flywheel opposes changes in the angular velocity. Opposes any acceleration or deceleration.

XQ. 184. Let us suppose that we are starting up a shaft that has a flywheel on it and bringing it up to speed. Does the flywheel oppose that starting and acceleration?

A. The flywheel exerts a counter-force tending to prevent the acceleration.

XQ. 185. So it opposes the acceleration, does it?

A. If you so interpret that statement, it does.

XQ. 186. And at the same time that the flywheel and the shaft are accelerating, does the flywheel store up any energy?

A. A certain amount of energy is transferred to the flywheel during that process if the process is one of acceleration.

XQ. 187. The flywheel does not act to prevent the beginning of the revolution of the shaft and the acceleration, does it?

A. It would have no effect as long as the shaft were revolving at constant speed. No effect whatsoever.

XQ. 188. I have not said anything about revolving at constant speed. I have started a shaft in revolution from rest, and I have accelerated the speed. Does the flywheel prevent me from doing that?

A. No.

XQ. 189. It slows up the rate of acceleration with a given applied force, doesn't it?

A. Not necessarily.

XQ. 190. Does it?

A. With a given applied force? You will have to explain exactly how that force is applied before I am able to give you an answer to that question.

XQ. 191. The flywheel opposes the acceleration speed, doesn't it?

A. Acceleration of velocity.

XQ. 192. The flywheel opposes the increase in the speed of revolution?

A. Yes.

XQ. 193. And what is the effect of that opposition?

A. Energy stored in the flywheel.

XQ. 194. Any other effect?

A. It may have some secondary effects on the motor and driving mechanism.

XQ. 195. Suppose I have a certain motor geared to a certain shaft that has no flywheel on it, and suppose I start the motor and bring up the shaft's revolution to a thousand per minute. I can do that, I suppose, with that particular motor, in a certain time, can't I?

A. A certain time, yes. There must be some time.

XQ. 196. But it will be a certain time? Not an indefinite time; but it will come up to speed in a certain time, depending on the size of the motor and the power from the motor and the weight of the shaft, won't it?

A. Yes, it would come up to speed eventually.

XQ. 197. In a definite time?

A. I don't think it would be a definite time, depending entirely upon other conditions in the mechanism.

XQ. 198. Assume all of the conditions you please, and assume the motor and assume the shaft, and you will get it up to speed some time, won't you? Let us stop there for the moment.

A. I don't know what you mean by "to speed."

XQ. 199. Get up to a thousand revolutions per minute.

A. If the motor is capable.

XQ. 200. You will get it up to that speed of a thousand revolutions, and a certain time will have elapsed by the time you have gotten to a thousand revolutions?

A. Yes.

XQ. 201. Instead of having a plain shaft, you have a shaft with a flywheel on it?

A. Yes.

XQ. 202. The same motor, and all the other conditions the same?

A. Yes.

XQ. 203. Will you get up to a speed of a thousand revolutions in the same time as you did before?

A. It depends entirely on the size of the motor.

XQ. 204. I said all of the conditions being the same except that you have added a flywheel.

A. The difference may be immaterial under certain conditions.

XQ. 205. All of the conditions being the same, except that you have added a flywheel?

A. Yes.

XQ. 206. And you will get up to that thousand revolutions at the same time as you did before?

A. Not exactly the same time; maybe slightly different.

XQ. 207. Would it be a shorter or a longer time?

A. In general the time will be somewhat longer.

XQ. 208. That is, a flywheel during that acceleration, stores up energy and slows up the rate of accelerations, doesn't it, other factors being the same?

A. If the motor is capable of producing a given speed without reference to torque, that statement would not be true. The flywheel would not appreciably slow up the action of the motor.

XQ. 209. I don't know what you are talking about when you are talking about torque, and don't let us

introduce things that may not be understood. Let us assume that you have a motor geared to a shaft and that has a certain flywheel on it. Let us assume that when you turn on the current to that motor, the result of it is that the speed of the revolution of the shaft and the flywheel is brought up to a thousand revolutions per minute in one minute. After one minute has elapsed. Can you assume that?

A. Yes.

XQ. 210. Now, suppose you make no change except to take off the flywheel and then turn on the current of your electric motor: will you get up to a thousand revolutions per minute in less than a minute or more than a minute?

A. It depends very largely on the relative sizes of the flywheel and the motor. If the motor was, say, ten horsepower and we had a flywheel two inches in diameter, I would say the difference would be absolutely immaterial.

XQ. 211. That is, you have not then got much flywheel effect from the flywheel itself?

A. No, we might have considerable flywheel effect. It is a question of how much the storage of energy slows down the speed of the motor. If the motor is a very powerful motor and the energy transformed into the rotating flywheel is small, the difference would be very small, if not negligible.

XQ. 212. Now, let us look at your colored chart of Defendants' apparatus PS16-A. What is shown in red is the flywheel, isn't it?

A. Yes, sir.

XQ. 213. And that is on a shaft?

A. It is mounted on a shaft.

XQ. 214. How is the shaft driven?

A. The shaft is driven through a spring.

XQ. 215. That is the one with the spring device. Let us take the other.

A. This is the other apparatus.

XQ. 216. Well, we get the motor which we have been talking about, Complainants' Exhibit 16-F. We will have to go back, then, to the other illustration; go back to Plaintiffs' Exhibit 16-A. There is a spring driving that red flywheel there, isn't there?

A. Yes.

XQ. 217. And that red flywheel is on a shaft?

A. Yes.

XQ. 218. And you know the force of the spring, do you?

A. No.

XQ. 219. Suppose that the spring there exerts its action to start that shaft in revolution and the flywheel in revolution: can we assume, are you willing to assume anything with me, that you will get up to a thousand revolutions per minute in one minute, with that flywheel on there and that spring?

A. I can assume that under certain conditions that might be true, to go along with you, Mr. Neave, yes.

XQ. 220. Take any elapsed time, if you wish. Do you want any other?

A. All right.

XQ. 221. One thousand revolutions in one minute; that is, you would reach a speed of one thousand revolutions in one minute. Suppose you take the flywheel off and have the spring action on the shaft just the same: how soon will you get up to one thousand revolutions per minute? Will you do so in one minute or in a longer time or in a shorter time?

A. It depends largely on the characteristics of the motor.

XQ. 222. Don't you know anything about this apparatus? I am talking about that apparatus there.

A. Well, you will have to specify what kind of motor is being used with this apparatus.

XQ. 223. The same motor that is actually used with the apparatus.

A. There are several different types of motors used with this apparatus.

XQ. 224. The diagram Plaintiffs' Exhibit 16-A, what type of motor is used?

A. I don't know.

XQ. 225. What type of motor is used in the Defendants' PS1 sound apparatus?

A. I don't know. I understand that it is applied with several alternative types of motor to it.

XQ. 226. Can you think of anyone?

A. Yes.

XQ. 227. What one?

A. I can think of a direct current motor.

XQ. 228. Well, then, let us assume that a direct current motor is geared to the sprocket shaft that has a flywheel on.

A. Yes.

XQ. 229. Very well. And we assume that the defendants' direct current motor, applied to that shaft that has the flywheel on, and we assume that the flywheel gets up to one thousand revolutions per minute in one minute. Can you assume that?

A. Yes.

XQ. 230. Now, take the flywheel off. How long elapsed before the shaft gets up to one thousand?

A. The rate of speed at which the direct current motor accelerates is determined very largely by how rapidly the operator moves the starting handle over the various points until it comes to full speed.

XQ. 231. Well, if he moves the starting handle over it at the same rate in each instance?

A. If he moves it over at the same rate in each instance they would probably come up to the same speed at about the same time.

XQ. 232. The flywheel has nothing to do with it?

A. If he moves the starting handle over at relatively the same rate, the armature current would probably be slightly different in the two cases and there probably would be very little difference in speed-in time.

XQ. 233. The flywheel then, would you say, has no effect on the acceleration?

A. No.

XQ. 234. What effect has it?

A. It probably has the effect of slowing down to some slight degree the acceleration, under given conditions.

XQ. 235. That is a measure of the stored up energy, isn't it?

A. Not necessarily. We might——

XQ. 236. Never mind the "necessarily." Is it?

A. No, it is not.

XQ. 237. What is it that causes energy to be stored up in the flywheel?

A. Its rotation and its property of having a moment of inertia.

XQ. 238. A flywheel arbsorbs and stores up energy only while its speed of revolution is being increased, doesn't it?

A. It stores up energy dependent upon the speed of revolution; not whether or not it is being increased. It may be revolving at a constant velocity and it will still store up energy due to its rotation. It is not essential that it must be increased in speed, to have energy stored up in a flywheel.

XQ. 239. Let us assume that you have a flywheel on the shaft and you accelerated the rotation of that, the revolutions of that shaft till you get to 1000 revolutions per minute; then let us assume that that shaft continues to rotate at precisely that rate with absolutely no variations in speed long or short: does the

flywheel keep on storing up additional energy while you are running at that constant speed?

A. It doesn't store additional energy while running at constant speed, no.

XQ. 240. No. It only stored energy while getting up to speed?

A. No. It has a certain amount of energy stored into it proportionate to the square of the angular velocity, the square of the speed of rotation and its inertia, its moment of inertia.

XQ. 241. Well, does it store up energy while it is increasing in speed?

A. Store up additional energy, Mr. Neave?

XQ. 242. Store up any energy while it is increasing in speed?

A. It is storing up additional energy while it is increasing in speed, yes.

XQ. 243. Is it storing up any energy while it is continuing to rotate in exactly constant speed?

A. Yes, it has energy stored in the flywheel during constant speed rotation.

XQ. 244. And where does it draw that from?

A. It doesn't draw it from. It resides in the flywheel itself.

XQ. 245. And it is absorbing—storing up additional energy while going at constant speed?

A. No, I didn't say that; I didn't say that.

XQ. 246. While bringing the flywheel up to one thousand revolutions per minute you have stored up energy in the flywheel, haven't you?

A. Yes.

XQ. 247. Then after getting up to one thousand revolutions per minute, suppose you run at absolutely constant speed, no variations, large or small.

A. Yes.

XQ. 248. Does it store up additional energy?

A. There is energy stored in the flywheel due to its rotation.

XQ. 249. Does it store up additional energy?

A. There is no change in the energy of rotation, as long as the speed is constant.

XQ. 250. Does it store up any more energy then?

A. No.

XQ. 251. Then all the energy that it has stored in it it got during the acceleration of speed, didn't it?

A. Yes.

XQ. 252. And it won't store up energy unless there is acceleration of speed, will it?

A. We are apparently not talking the same language, Mr. Neave. A flywheel rotating at a constant speed certainly has energy stored into it.

XQ. 253. I didn't say that.

A. Not a slight bit of change of speed.

XQ. 254. Can't you imagine a flywheel standing at rest, not rotating at all?

A. Yes.

XQ. 255. It has no energy stored in it, has it?

A. True.

XQ. 256. Can you imagine it being started into rotation then and carried up and speeded up to one thousand revolutions per minute?

A. Yes.

XQ. 257. During that time, while the speed is accelerated, it is storing up energy, isn't it?

A. It is storing up energy, whether the speed is accelerating or not.

XQ. 258. Then suppose the speed stops accelerating?

A. Yes.

XQ. 259. So that you are running along absolutely uniform speed: does it store up more energy?

A. The amount of energy stored in the flywheel is constant. It does not store any more energy, no, but there is energy stored in the flywheel.

XQ. 260. So that all the energy that it got stored in it, it got during the time that the speed was accelerated?

A. That is true, yes. That is true.

XQ. 261. Then suppose, having gotten it to one thousand revolutions, you decrease the rate of revolution, decrease the revolutions, slow it down to 500 instead of 1000: the stored up energy in the flywheel will be given out, won't it, or given up during the time that speed is decreasing?

A. Yes. Some mechanism must be employed to take out some of the stored energy from the flywheel in order to slow it down.

XQ. 262. And the stored energy in the flywheel is given out only when and while the speed of revolution of the flywheel is being reduced: isn't that true?

A. The kinetic energy of rotation is decreased by a decrease in speed.

XQ. 263. The stored energy in the flywheel is being given out only while the speed is decreasing: isn't that true?

A. The energy due to its rotation and its moment of inertia. Of course, other energy may be given out due to the drive of the flywheel.

XQ. 264. What other energy given out?

A. If the flywheel is rigidly connected to a pulley—to a pair of pulleys, one of which is driving the flywheel and the other of which is absorbing energy, there may be of course energy transferred to the pulley without any variation of speed.

XQ. 265. That is not the stored energy of the flywheel, is it?

A. No, it is not the stored energy of the flywheel.

XQ. 266. Well, will you listen to my question, please. Suppose you have got a shaft that is rotating, that is revolving at one thousand per minute; and you have stored up energy in getting to that, haven't you? You have stored up energy in the flywheel?

A. Yes.

XQ. 267. Now, supposing you decrease the speed of revolution to 500: some of the energy that has been stored up in the flywheel is given out, isn't it?

A. That is true.

XQ. 268. And it is given out only during and while the speed is decreasing, isn't it?

A. The kinetic energy, as far as the kinetic energy is concerned, yes.

XQ. 269. Why do you keep putting in kinetic energy? I am speaking of energy stored in the flywheel. Do you hear me say anyhting about kinetic energy?

A. Energy may be transferred to the flywheel due to the drive from other pulleys.

XQ. 270. That is the reason why I asked you to listen. Energy stored in the flywheel is given out only during a decrease in speed, isn't it?

A. I answered that question several questions back, Mr. Neave; yes.

XQ. 271. What is the answer?

A. Yes, of course.

XQ. 272. Only while the speed is decreasing?

A. Yes.

XQ. 273. So up to this point we seem to have gotten—I want to say it again, so as to be sure we are in agreement—to this: that the flywheel absorbs and stores up energy only while its speed of revolution is being increased, and gives up some of that stored energy only while its rate of revolution is being decreased: do you agree with me?

A. Yes.

XQ. 274. Suppose we have a certain flywheel on a shaft and revolve the shaft at a certain speed—say 250 revolutions per minute; and then quadruple the speed, bringing it up to one thousand revolutions per minute: to what extent is the energy stored up increased?

A. The energy stored is in the ratio of the square of the rotational speed. If it is quadrupled, there would be sixteen times as much energy stored at one thousand revolutions per minute as there would be at 250.

XQ. 275. And that is of course true irrespective of the 1000 and 250 if the speed is quadrupled?

A. It is the relation.

XQ. 276. And the flywheel effect is increased that much, isn't it, sixteen times?

A. If by flywheel effect you mean the energy storage, I should agree with you. The flywheel itself has a constant moment of inertia, irrespective of what speed it may be rotating. So that that flywheel effect of a given flywheel would not be varied by the speed of its rotating.

XQ. 277. The effective work that may be done by the flywheel is varied in the same amount, sixteen times, isn't it, under the assumed conditions—that is, when you quadruple the speed you have stored up sixteen times as much energy as you have before, so you have sixteen times as much energy that may be given out in a decrease in speed, haven't you?

A. That is right.

XQ. 278. Now, the effect then—and that is the effect I am speaking of—is changed not entirely, but only in amount, isn't it, whether you have sixteen times the amount of energy or twice the amount of energy we originally had, you still have the same kind of power there that you could utilize by the flywheel giving out that energy on a decrease of speed but not the same amount: isn't that right?

A. The flywheel stores only kinetic energy.

XQ. 279. So that when you increase the energy by sixteen times, you have increased the amount of energy that it is storing up to give out, but you have not changed its kind of operation at all, have you?

It gives out sixteen times the energy in the same way that it gives out twice the energy, doesn't it?

A. It is still kinetic energy, merely varying the amount.

XQ. 280. Yes. My only difficulty is that you keep on with the kinetic energy, and I don't know but you are trying by that to say something different from what I am trying to say. What is kinetic energy?

A. Kinetic energy is the energy stored in the flywheel due to its rotation.

XQ. 281. All right. I think we talk the same thing.

A. I think we are in perfect agreement on that.

XQ. 282. Now, suppose we have a certain flywheel on the shaft revolving one thousand revolutions per minute, and on another shaft another flywheel of the same shape but of only half the diameter, and this second flywheel is running at the like rate of revolution, namely, one thousand revolutions per minute: how does the amount of stored energy or the flywheel effect differ in the two instances?

A. The moment of inertia of a solid flywheel of a given thickness—that is, measured axially—varies as the fourth power of the radius—or the fourth power of the diameter. If these two flywheels were of exactly the same thickness, measured along the shaft, and one was twice the radius of the other and of exactly the same materials, the ratio would be as the fourth power of their diameters.

XQ. 283. That sounds complicated to me. Can't you make it simpler than that?

A. Why, certainly. Two to the fourth power is sixteen. Sixteen to one, that is correct.

XQ. 284. And the smaller flywheel, the half-sized flywheel, running at the same speed as the other, stores up only one-sixteenth as much energy; is that true?

A. I think that is correct.

XQ. 285. Now, let us speed up this second flywheel; that is, the smaller flywheel; we can come, can't we, to a speed at which the stored energy or the flywheel effect of the smaller flywheel is the same as that of the larger flywheel?

A. Yes.

XQ. 286. Now, a few minutes ago we were assuming the flywheel on a shaft, the speed of revolution had been accelerated to run at a constant speed of 1000 revolutions per minute, and we had then brought down the speed so that the shaft ran at a constant speed of 500 revolutions per minute. Now, instead of assuming such a great change in speed let's assume that the shaft continues to run at the average speed of 1000 revolutions per minute, but that there are some slightly short lived variations in that speed—let's look at just one variation, to make it simpler: suppose that one short lived variation is a short lived decrease in speed—the effect of that decrease is to cause the flywheel to give up some of its stored energy, is it not?

A. Yes.

XQ. 287. And the flywheel in giving up some of its stored energy will reduce the rate of decrease of the speed, won't it?

A. I don't think that necessarily follows.

XQ. 288. What does follow?

A. You will have to specify under what the drive of the flywheel is, whether it is an absolutely constant speed motor, a variable speed motor, and there are many other conditions that you have to get to be able to predict the correct answer.

XQ. 289. Well, we agree, don't we, that the effect of the decrease in speed is to cause the flywheel to give up some of its stored energy?

A. Yes.

XQ. 290. Now, in defendants' machines, that you are assumed to know about, what is the effect of a fly-

wheel giving up some of its stored energy: the immediate effect?

A. A difference in speed. A deceleration, a slight decrease in speed.

XQ. 291. You mean then that when we have a short lived decrease of speed of the shaft the flywheel increases that decrease in speed? I didn't understand your last answer.

A. I didn't intend to say that.

XQ. 292. Well, what was it you meant then? We have assumed a short lived decrease in speed.

A. Yes.

XQ. 293. The flywheel gives up some of its stored energy. What is the effect of that?

A. I am not quite sure as to the significance of that question, Mr. Neave. The flywheel, as I understand it, has decreased in speed and some of the energy of the flywheel has been transformed into some other form. Without other details I really can't answer it.

XQ. 294. I don't see that you need anything else. But let's put it this way: let's assume that there was no flywheel there, in these defendant's machines——

A. Yes.

XQ. 295. And let's assume that there was a short lived variation in the speed of the shaft; that would have a bad effect on the picture film, wouldn't it?

A. Yes, it would have exactly the same effect, whether there was a flywheel present or not. If by the shaft you are referring to the flywheel shaft as illustrated in Exhibit 16-A.

XQ. 296. Yes.

A. Yes. The effect would be the same whether or not there were any flywheel on the shaft.

XQ. 297. The effect on the resulting picture?

A. Yes, absolutely. With the same speed variations in the shaft, there would be the same——

XQ. 298. But let us assume without the flywheel there, that you have a certain short lived decrease in speed of the shaft.

A. Yes.

XQ. 299. Now let us assume that you put the flywheel on. When there is that decrease in speed the flywheel gives up some of its stored energy, doesn't it?

A. Yes.

XQ. 300. What is the result of it? Does it increase that momentary variation in speed, or is it decreased, or what?

A. I assume that you intend to ask me—base your question on a slight change in the torque of driving the flywheel: if the speed variation is the same in both cases—as I assume, from your question, that it is—there would be no difference whether the flywheel is present or not.

XQ. 301. Stalled again then. Let's assume there is no flywheel there.

A. Yes.

XQ. 302. And there is a speed variation of a short lived decrease in speed. Something has caused that, I suppose; things don't happen without cause, do they?

A. No.

XQ. 303. Now, suppose you put the flywheel on and the same thing that caused that short lived variation in speed acts again, and tends to cause that short lived variation in speed—decrease in speed; the flywheel gives up some of its stored energy, doesn't it?

A. Yes.

XQ. 304. And now, what does that do to what was before the short lived variation in speed? Now, have you got that clear?

A. Yes, yes; quite clear now.

XQ. 305. All right.

A. It tends to reduce the variation in speed, to decrease the speed fluctuation under those conditions.

XQ. 306. Yes. That is, with the flywheel on, the sharp decrease in speed, short lived decrease in speed is not so great a decrease as it was before, as it was without the flywheel on.

A. Yes. Conditions may be so as to produce that result.

XQ. 307. Well, is that what happens? Is that what the flywheel does in the defendants' machine?

A. In general, that is the effect of the flywheel.

XQ. 308. I mean every day, in the working of it, is that what happens?

A. The flywheel effect.

XQ. 309. And that effect takes place, as the flywheel gives out energy—gives out some of its stored energy, you make smaller a decrease in speed that would have been larger without the flywheel, only in response to a decrease in speed of revolution of the flywheel, isn't it?

A. Yes.

XQ. 310. Now, the flywheel having in accordance with the example we made just now, having given out some of its stored energy because of this tendency to abrupt decrease in speed, how does it get that energy back again,—or does it continue running thereafter with the decreased energy?

A. If the driving motor tends to maintain constant speed the flywheel is speeded up through the action of the driving motor.

XQ. 311. So that it will then absorb more energy?

A. So that it is then absorbing a little additional amount of energy.

XQ. 312. Professor, we were assuming this morning that some short lived variations have produced decreases in speed, in which event the flywheel gave up some of its stored energy and made the variation less than it otherwise would be. Now, let us suppose the

variation produced a short temporary increase in speed in the shaft and the flywheel likewise would make that increase smaller than it otherwise would have been and, in doing so, absorbs and stores up some additional energy instead of giving it out. So that in either case, whether a short lived reduction in speed or a short lived increase in speed, the only thing which causes the flywheel to have a flywheel effect is a variation of the speed revolution, large or small.

A. I don't think that that is an exactly accurate statement, because the flywheel has a flywheel effect, whether it is rotating or not. A flywheel is a flywheel whether it is in motion or not.

XQ. 313. What effect has a flywheel when the shaft on which it is fixed is standing still?

A. The flywheel still has a moment of inertia, which is unchanged.

XQ. 314. Has it any energy stored up in it when it is standing still?

A. No. So far as the storage or increase of stored energy or decrease, that is true with regard to the speed variation, but the flywheel effect is due to the dimensions of the flywheel.

XQ. 315. The flywheel effect, to my mind, does not become an effect until it is exercised,—that is, when the speed decreases, the effect of the flywheel is to minimize the decrease in the speed, make it less than it otherwise would be, and in that the flywheel gives up some of its stored energy, as I understand, is what you said this morning?

A. Yes.

XQ. 316. And if there is an increase in the speed the flywheel makes the increase less in quantity than it otherwise would have been and, in doing this, it stores up some additional energy, because it runs at the higher speed; that is true, isn't it?

A. Yes.

XQ. 317. Now, in the defendants' machine what is it that can cause the variations in the speed of the shaft to which the flywheel is attached? What I have in mind is I am trying to find out whether gears cause such variations and the sprocket teeth and the perforations of the film coming into the sprockets; is that that kind of thing that causes variations that the flywheel is used to make smaller?

A. The items that you have mentioned may cause speed fluctuations, and I assume that they perhaps do in the defendants' machine.

XQ. 318. Anything else in the defendants' machine that makes the fluctuations which the flywheel is intended to minimize?

A. There may be momentary changes in the speed of the driving motor; anything that would produce a change in the rotating torque applied to the flywheel would have that tendency.

XQ. 319. Or momentary change in the load on the shaft, increase in resistance to motion or decrease in resistance to motion?

A. That is probably of little or of—strike that out. That is probably of minor effect, because the load in driving the film is very nearly constant and does not perhaps vary to the extent that some other factors do in the defendants' machine.

XQ. 320. There is some load in the film on passing through the film gate, is there not?

A. There is.

XQ. 321. And that I suppose varies slightly from time to time?

A. It may.

XQ. 322. And that would cause an increase or a decrease in the speed of revolution of the flywheel, wouldn't it?

A. To a very slight extent.

XQ. 323. But variations, whether they are caused by the gears or the sprockets and the holes in the film, or by an increased or decreased load on the shaft that is revolving—irrespective of why the variations are caused, the flywheel acts just the same, doesn't it?

A. The flywheel does not tend to iron out the variations in the speed of the gears. It merely prevents these variations from reaching the film.

XQ. 324. That is what I mean.

A. So there is a different action, depending upon where the source of variation lies.

XQ. 325. But whether the variation lies in the gears or in the sprocket holes and so forth in the film, or in the load on the shaft, the flywheel acts in the same way, to smooth out those variations, to minimize those variations?

A. That is true.

XQ. 326. Now, referring to the defendants' machines, shown in the colored charts 16-F and 16-C, there is a flywheel in the projector part, isn't there, as distinguished from the sound part?

A. Yes.

XQ. 327. What is that that causes variations in the projector part that the flywheel there is designed to minimize the effect of?

A. The projector is called upon to move the film in a certain portion of the cycle at a very rapid rate. During the rest of the cycle the film remains stationary before the projector gate. And it is continually called on to supply momentarily a comparatively large amount of energy and can store up the energy lost during this period during the rest of the cycle.

XQ. 328. How many revolutions per second does the flywheel in the projector make?

A. It makes one complete revolution for each picture shown. And if the projector head is showing twenty-four pictures per second, it would give it a

speed of twenty-four revolutions per second, or 1440 per minute.

XQ. 329. And how many revolutions per minute does the flywheel in the sound head make?

A. One-fourth of that; 360 revolutions per minute.

XQ. 330. The amount of energy that is stored up in the flywheel is dependent in part upon the speed of the flywheel, isn't it? Speed of revolution?

A. Yes.

XQ. 331. And when that flywheel in the projector head is—as is shown on the drawing—smaller than the flywheel in the sound head, the stored energy and the amount of flywheel effect of each may be the same or the smaller flywheel may have even more stored energy than the larger one, may it not?

A. That is largely a matter of facts in the case. A small flywheel revolving at an abnormally high speed may store up more energy than a larger flywheel revolving at a slower speed.

XQ. 332. And that may be true of the defendants' apparatus? You haven't figured it out, have you?

A. Without further consideration I can't answer that question.

XQ. 333. Uniform motion of a film or of shafts or rollers is an ideal not practically obtainable, isn't it? You may only approximate doing it?

A. From a physical standpoint there is nothing absolutely uniform in the universe that we know of yet.

XQ. 334. And the films in the defendants' machines do not move at an absolutely uniform rate, do they?

A. From a practical standpoint their uniformity may be so nearly approached to absolute uniformity that it is humanly impossible to detect the difference. Of course, it is impossible to get an absolute physical uniformity.

XQ. 335. The extent to which you get that uniformity or approach the uniformity is a matter of degree in every case, isn't it? You may come nearer to it or further from it but you can never absolutely attain it?

A. It comprises both degree and kind. There are different types of non-uniformity. Of course, they may be of different degrees.

XQ. 336. And in order to get the film in these machines, in these sound heads, moving at a reasonably uniform constant rate of speed, one has to be careful, I suppose, in designing the other parts of the machines, for if they are not properly designed you cannot get a satisfactory uniformity of motion, even though you do use flywheels. I suppose that is so, isn't it?

A. That is true.

XQ. 337. Are there any instructions in the patent here in suit as to the size or weight or design of the flywheels?

A. Yes. The design is quite clearly indicated.

XQ. 338. What is the design to be?

A. As shown in the drawings, Figures 3 and 4, and 5 and 6. Also Figures 1 and 2.

XQ. 339. What is the design?

A. Figures 1 and 2 show but end views of the flywheels involved, whereas Figures 3, 4, 5 and 6 indicate both end views and the cross-sectional drawings.

XQ. 340. There is, of course, no necessity for making them just that way? That particular form does not do any better than any other form, does it?

A. There is a certain advantage in having the—I might say quite an essential advantage in having the mass of the flywheel concentrated towards its outer edge, as indicated in some of the drawings, because under certain conditions the total weight of the flywheel would be less, very much less than if the mass

were concentrated near the axis, and it may at the same time give the requisite inertia effect.

XQ. 341. That was an ordinary principle of flywheel design, and has been for years, hasn't it?

A. Many flywheels were designed with the mass so concentrated.

XQ. 342. The specification gives no warnings or hints as to just how to design the flywheel, does it?

A. The shapes of the flywheels are not specified other than as shown in the drawings.

XQ. 343. Were the weights specified anywhere?

A. The weight is not specified anywhere except, of course, by comparisons with other dimensions shown on the drawings which are of standard values.

XQ. 344. Other dimensions of standard value?

A. Yes.

XQ. 345. Standard where?

A. The spacings between the two rows of perforations on motion picture film are, so far as I know, standard in this country and abroad.

XQ. 346. And the sprockets are standard?

A. The sprockets are standard?

XQ. 347. Were standard at that time? There is no description of any special sprocket there, is there?

A. The size of the sprocket is not specified, no.

XQ. 348. It just leaves that to the knowledge of the art, just as it does how to build a flywheel?

A. No, I would not say that at all.

XQ. 349. What is there that this patent teaches you particularly as to the size or weight or anything of the sprockets or of the flywheel?

A. The distance between the rows of perforations in Figure 3, which corresponds to a distance of approximately one and one-sixteenth inches in standard film today, and in the past, indicates that the diameter of this flywheel is several inches in diameter, and that

this width is approximately a considerable fraction of an inch at the edge.

XQ. 350. Any special advantages specified for that particular size?

A. The size of the flywheel is not discussed in the specification other than in general terms. If the spring is not used, the flywheel must be of very large dimensions.

XQ. 351. Is there anything in the patent about the speed of the film or the speed of rotation of the sprocket wheels or the speed of rotation of any part?

A. The patent, as I understand it, is not limited in its application to any particular speed of driving of the film except that the speed must be rapid and uniform.

XQ. 352. Is there anything in the patent about the film being a motion picture film?

A. Yes, there are several things mentioned. The term "picture cinematography" is mentioned on line 109, page 2. This term is used again in page 3, line 12, and the drawings make a special provision for a picture space on the film. While this patent is not limited to a film which contains both pictures and sound, yet special provision is made so that if it is desired to use pictures, then it is very conveniently done.

XQ. 353. Then the patent presupposes a knowledge of motion pictures and motion picture machines?

A. Moving picture machines were of course known prior to the filing date of this patent.

XQ. 354. The patent specifies nothing about how the parts are driven, does it? That is, by what prime mover, electric motor or spring or what?

A. It is not essential, of course, that a particular type of drive be employed, but the patent, of course, calls attention on page 1, line 13:

"Consequently, it has hitherto been usual to provide apparatus such as phonographs and gramophones with speed regulators."

And it is quite obvious that speed regulators of some character were intended.

XQ. 355. Speed regulators to regulate what?

A. Speed of the driving mechanism.

XQ. 356. And what kind of driving mechanism does it presuppose?

A. It does not presuppose any particular kind of driving mechanism, any particular type. The main requirement is, of course, that it must be of constant or nearly constant driving speed.

XQ. 357. And these speed regulators that the patent says were used on other phonographs and on phonographs and on gramophones—they regulated the speed of the spring motors and electric motors as well, I suppose?

A. Some were very poor; some were more effective.

XQ. 358. Some regulators were poor, you mean?

A. Yes.

XQ. 359. And they regulated the speed of the spring motors or of the electric motors, or at least they tried to regulate the speed of the spring motors or electric motors?

A. Yes.

XQ. 360. The driving of any of these things by electric motors was something that was known prior to the time of this patent?

A. I don't think the patent claims electric motor drive as a novelty.

XQ. 361. It speaks of a motor at one place, so I suppose that can be either spring or electric.

A. Any convenient suitable type of motor.

XQ. 362. Look at page 2 of the patent at line 22. Beginning at line 20, it says:

"As the roller is rigidly connected with the rotating mass m, or can be constructed so as to be itself the rotating mass," and so forth.

How would you construct the roller so as to be itself the rotating mass?

A. I would take a large sized chunk of iron or other metal and turn the flywheel to the proper diameter, and then turn part of the remaining portion down to the diameter to be used in the roller.

XQ. 363. The roller and the flywheel then are integrally connected together; is that right?

A. Yes, they are the same unit.

XQ. 364. That is the same as rigidly connecting them, isn't it?

A. Obviously, if the rollers turned down on a portion of the flywheel, and there is but a single unit involved, the connection is rigid.

XQ. 365. The problem, if there was one, which these patentees were trying to solve, arose, I gather, from their patent, of having the sound record out of something of inconsiderable mass. Is that what you gather from the patent?

A. That is one of the problems.

XQ. 366. Was there any other problem at the basis of this?

A. Yes, there are many other problems. The question of reproducing by a line of light, maintaining the line of light at proper focus, and many other incidental problems which are essential if the effect of the uniformity of motion is to be realized.

XQ. 367. One thing, at any rate, they were working on, was the problem arising out of having the sound record out of something of inconsiderable mass, and trying to have of a uniform constant motion?

A. Yes, that was one of the problems.

XQ. 368. That was the same problem, irrespective of the method of recording the sound, was it not,

whether the sound was recorded on the film photographically, or by indenting, or whether it was recorded on a light piece of metal magnetically, or whether it was recorded on a film by inking. The problem was the same in each instance, wasn't it?

A. No, I don't think the problem was the same. The problem, as far as the lack of inertia was concerned, involved certain arrangements to solve it, but there are many other problems induced with these other types of records, which are not present in a photographic record, and vice versa.

XQ. 369. But the problem, so far as having a record of inconsiderable mass, was the same in each of these instances?

A. The problem involved in having a record of inconsiderable mass is always present when you have a record of inconsiderable mass.

XQ. 370. On page 1 of the patent it says:

> "The recording and the reproduction of sound waves by the use of linear phonogram carriers such as film strips, steel wires, and so forth."

Now, that presupposes, doesn't it, the prior existence of linear phonogram carriers, such as film strips, steel wires and so forth?

A. There were, of course, prior to the date of the filing of this patent, film strips and steel wires, the use of which, for recording sound, had been attempted.

XQ. 371. What are film strips?

A. Film strips, in normal parlance, would be strips of celluloid usually covered with photographic material, the way we refer to them today.

XQ. 372. And it would still be a film strip if there would be no photography used, but if the sound were indented on the film or inked on the film, for instance. wouldn't it?

A. That is not the common accepted use of the word, according to my information.

XQ. 373. It would be the same, wouldn't it, it would be a film if there were indentations on it, or ink on it?

A. When we speak of film today we usually speak of something that has a photograph on it.

XQ. 374. What does "steel wires" mean? What does that imply with reference to a sound record?

A. A steel wire was used in some experiments with the Poulsen Telegraphone in which the wire was magnetized to a greater or less degree, in accordance with the record being made.

XQ. 375. That is, the sound record was magnetically placed on the wire and magnetically taken off?

A. Yes.

XQ. 376. What does the "and so forth" mean in line 4?

A. In other types of sound records that have inconsiderable mass.

XQ. 377. What were they?

A. I do not think at the moment of any other type of record.

XQ. 378. Whether the sound is recorded photographically or otherwise on the film, or magnetically on a steel wire, or by indenting on a cylinder, or cutting, or indenting on a disc, in each instance it is desirable, is it not, that during the recording the carrier upon which the recording is to be made shall move with as nearly as possible an absolutely constant speed, and for reproducing it shall move as nearly as possible at an absolutely constant speed?

A. Certain types of recording are inherently so poor in characteristics that the presence or absence of constant speed makes very little difference in the final result, of course, if you change the speed over

a variation of 50 per cent., it will probably show up in almost any type of recording.

XQ. 379. Well, the disc records give a very good reproduction, don't they?

A. The disc records, at the date of the filing of this patent, were in many cases very, very poor.

XQ. 380. In many cases they were very poor and are now, but there are some that are very good in either type, aren't they?

A. Of course, there has been considerable development in disc records since the filing date of this patent.

XQ. 381. Would you say that it was desirable with disc records, and with cylinders, to have the rate as far from uniform as possible?

A. No. It is not desirable to have them as far from uniform as possible.

XQ. 382. It is desirable to have them as nearly uniform as possible, isn't it?

A. Of course, in a disc record the speed of recording and reproduction is not constant. It varies from a relatively low value when the recording stylus is on the inside of the record and revolving over a small radius to a high value when the recording stylus or reproducing stylus moves further out from the center; so in the case of the disc record, at least, the question of constant speed is neither desired nor attained.

XQ. 383. Are you speaking of a different constant speed from what I am speaking of?

A. I am speaking of constant linear speed over a recording point.

XQ. 384. Whether you are recording or reproducing from the outer or inner edge of the disc, you don't want to have any little jumpy variations, do you? That is, the average speed may be higher, if it is higher, near the middle of the disc than it is over to

the outside, or vice versa; but you don't want to have little variations in that average speed, do you?

A. No, I don't think that speed is correct. The average speed is much higher when the needle is towards the outside of the disc than when it is towards the middle of the disc.

XQ. 385. But you don't want to have little variations in that speed, do you?

A. No. You want the speed to change gradually, to change gradually, to decrease gradually, from one end of the record to the other.

XQ. 386. So it is important there to have a gradual decrease instead of a jumpy decrease, isn't it?

A. Yes, the gradual decrease is better in that type of record, for good reproduction.

XQ. 387. Now, look at line 38, page 1, of the patent. It speaks about "the slot, magnet and condenser." The slot is the slit for the light to go through?

A. I have not so interpreted it.

XQ. 388. What do you think it is?

A. By the "slot" I assume it is the long elongated opening down which the film passes. And the mechanism which draws the film past the projection gate.

XQ. 389. The mechanism?

A. It is the elongated opening that draws the film past the sound gate or perhaps the picture gate.

XQ. 391. How does the elongated opening draw a sound record? The sound record is drawn after the elongated gate is opened, isn't it?

A. We are not talking about the same elongated opening, Mr. Neave.

XQ. 392. Well, what one are you talking about? Refer to the patent. Where is it in the patent?

A. The patent does not show any picture projecting apparatus, and I have assumed that this slot refers

to the picture gate on the picture-projecting apparatus.

XQ. 393. I thought you said a moment ago that the slot drew the film?

A. The film is drawn through the slot.

XQ. 394. The film is drawn through the slot on the projector?

A. Yes.

XQ. 395. Not on the sound head?

A. Not in the construction of the patent illustrations.

XQ. 396. What is the "guiding point" in the patent?

A. The guiding point, used in connection with the slot would be the point at which the picture is projected.

XQ. 397. Well, refer to any one of the drawings and tell me where the guiding point is?

A. Of course, it is not shown on the drawings, because the drawings do not show the picture projection apparatus.

XQ. 398. What do you find in that sentence, in lines 33 to 41, talking about picture projection apparatus?

A. I find the word "projections", which I assume of course means the projection of the picture. This appears in line 35, reading—beginning the line 33, quote: "Irregularities in the motion such, for instance, as may be caused by the projections." Which definitely shows that the picture projection is indicated.

XQ. 399. So that slot you are talking of here—so this guiding point that is mentioned here is in the picture projector, is it?

A. As I read it in connection with the word "slot", it is.

XQ. 400. And then what is that magnet?

A. The magnet is the recording or reproducing equipment used in the steel wire.

XQ. 401. And what is the condenser?

A. I am unable to define the condenser. I think it is a mistranslation.

XQ. 402. A mistranslation of what?

A. I don't know, sir, from what it was translated.

XQ. 403. According to the patent, what "Dependable and highly effective optical system is provided"? And that is quoting from page 1, line 55.

A. The system by which a narrow converging line of light is projected on the film without the necessity of some material physical slit or opening rubbing upon the film.

XQ. 404. What is the optical system of this patent as disclosed there?

A. It is shown in Figures 2, 1, 3, 4 and 6.

XQ. 405. What is it?

A. It is a device by which a fine line of light is focussed on the surface of the film.

XQ. 406. What are the parts of the optical system that are shown in those figures?

A. A casing containing the objective lens o; and the direction of the lines of light emanating from the optical lens o.

XQ. 407. Is the lens a spherical lens or a cylindrical lens; does the patent say?

A. It is mentioned as an objective lens. Objective lens meaning the lens used towards the object in a telescope or miscroscope limits it very definitely to a spherical type lens.

XQ. 408. What means is shown and described for condensing the light to a narrow line at the surface of the film?

A. The action of the lens of course would do that.

XQ. 409. The spherical lens would do that?

A. A spherical lens will increase or decrease the size of a line of light so that it may be focussed at the surface of the film.

XQ. 410. In my understanding, the spherical lens would bring the line down to a point and not to a line?

A. Yes, if the initial source of the light were a point it would.

XQ. 411. Then the initial source has to be a line, according to the patent?

A. With a spherical lens it would be necessary to have something giving a line of light to produce the focussed line of light on the film.

XQ. 412. Then you are sure this was a spherical lens, are you?

A. I so assume it to be. I know of no microscopes or telescopes that have cylindrical lenses in the objective position.

XQ. 413. There is no telescope that I have ever looked through that gives a line of light.

A. Every telescope that I have ever seen in looking at a line of light indicates a line of light.

XQ. 414. Oh, sure. Is there any indication in this patent in suit that the light which is cast upon the spherical lens is to be a line of light?

A. As I understand it, there is no indication that any light is to be cast upon the lens; that the lens merely focusses down to a narrow line on the surface of the film some other source of light which gives that effect.

XQ. 415. And the source of light is to be what?

A. The source of light is some kind of a line source.

XQ. 416. A line source?

A. Yes.

XQ. 417. And the patent says that, does it?

A. The patent refers to an additional patent, on page 3, line 43, where such line sources are very defi-

nitely described and specified; and even though this reference were absent it would be quite obvious to anyone skilled in the art that using a spherical lens and the desired result being a line of light, one would have to start out with a line of light.

XQ. 418. Does the patent teach to make a line of light one one-thousandth of an inch wide? Perhaps I should say "thick." I mean in the direction of the length of the film.

A. The patent is not limited to the use of a line of light one-thousandth of an inch in thickness. But on every drawing shown the lines converge to an absolute minimum of width, as near as the draftsman can indicate such a convergence.

XQ. 419. Does the patent teach me how to make a photoelectric cell? It presupposes a knowledge of that, doesn't it?

A. There were photoelectric cells—the photoelectric phenomena had been discovered prior to the issuance of this patent.

XQ. 420. And does the patent add anything to the knowledge of photoelectric cells?

A. It does not add anything to the knowledge of the fundamental photoelectric action.

XQ. 421. Does it add anything to the knowledge of the construction of a photoelectric cell?

A. Yes, it shows how a convenient type may be constructed and shows that a photoelectric cell of small size is quite applicable for this type of work.

XQ. 422. And what does it tell me about the construction of a photoelectric cell?

A. It tells you that it may be made in such small sizes as to be located completely inside the sprocket and still have it effective, one of the things.

XQ. 423. It does not point out the making of it smaller than they have ever had it before, does it?

A. There is no statement to that effect in the patent. There seemed to be some doubt as to whether such small cells could be made, a few days ago in this case.

XQ. 424. Oh no, you misunderstood my questions then. Does the patent teach anything about the circuits that must be used with a photoelectric cell?

A. This particular patent does not treat on the circuits. There were prior applications which did show desirable circuits to be used with photoelectric cells published by these same inventors.

XQ. 425. Is there anything in the patent as to what the source of light shall be?

A. The patent is not limited to any particular source of light.

XQ. 426. Does it specify any source of light?

A. It specifies a source of light to produce an extremely fine bright line on the film. Now, there may be many different ways of doing that.

XQ. 427. Where does it specify that?

A. I think I am in error to mention "extremely bright." But the patent does specify in a number of places of the focussing of that narrow fine line upon the surface of the film.

XQ. 428. Where? Where does it specify that as having anything to do with the source of light?

A. The line of light of course emanates from the source of light.

XQ. 429. Now, what source of light is disclosed here?

A. The patent is not limited to any particular source of light.

XQ. 430. What source of light is disclosed here?

A. There is no definite source of light disclosed.

XQ. 431. Leaves that for the general knowledge, too, doesn't it?

A. One skilled in the art could very easily find the proper source of light.

XQ. 432. In Figure 1 of the patent what means are shown for causing the film to travel under tension?

A. The statement is made that the film should be under tension between the upper and the lower rollers, which of course might be accomplished in a number of different ways, one or both rollers might be spring-supported on their bearings; or perhaps a simpler device would be to utilize the tension rollers shown in Figure 2, which are definitely described as to have the function of producing tension on the film.

XQ. 433. The patent shows or describes no means for causing the film to travel under tension in Figure 1, does it?

A. Yes. The Figure 2 shows very definitely a means for causing the film to travel under tension around the roller. And it would be obvious to one skilled in the art, if such necessity arose, to apply these same rollers to Figure 1.

XQ. 434. In Figure 1 the film is shown coming up from the left and going down at the right. Where does it come from and go to?

A. It of course comes from some feeding reel and finally ends up on another winding up reel.

XQ. 435. Comes directly from the feeding reel?

A. Not necessarily, because in connection with several other figures the existence of a free loop is specified between the ends of the film, as shown on the figures. If such should be desirable, the patent definitely describes the possibility of such an arrangement to be applied to Figure 1.

XQ. 436. Now, the rollers $dr_1$ and $dr_2$ in Figure 1 are spring-pressed—I think you said?

A. That is customary in rollers of this character.

XQ. 437. So as to press the film against the roller $r_2$?

A. Yes.

XQ. 438. There is a physical slit shown in Figure 1, isn't there?

A. By physical slit, do you mean an opening directly at the surface of the films?

XQ. 439. Yes.

A. No, I do not see any physical slit.

XQ. 440. That is, the physical slit is on the side of the film away from the objective, is it?

A. In Figure 1 I see no physical slit there at all.

XQ. 441. In Figure 1 don't you see the rays of light converging at the film and then going on?

A. Yes.

XQ. 442. And don't they go on through a slit? What is that opening there in that hollow cylinder?

A. No, that is merely a wide opening in the casing which protects the photoelectric cell from mechanical damage. The rays are——

XQ. 443. The light goes through a slit there, does it not?

A. The rays are very much narrower. They are not limited by the opening at all.

XQ. 444. I know that. But that is a slit there, isn't it? I am trying to find out what it is according to the figure.

A. If you call a very wide opening a slit, that probably might be considered as a slit.

XQ. 445. It is a slit in what?

A. It is a wide opening to allow the light to pass into the container that holds the photoelectric cell.

XQ. 446. In Figure 2 what holds the film from falling away from the sprockets V and V2?

A. The follow-up rollers; such as those shown perhaps in Figure 1.

XQ. 447. Not as shown or described?

A. The rollers are described in connection with Figure 1 and shown, yes.

XQ. 448. And what is the effect of springs on $dr_1$ and $dr_2$ in Figure 2?

A. They press the rollers against the film and produce——

XQ. 449. Wait a minute. Press the rollers. I beg your pardon. Excuse me.

A. They press the rollers $dr_1$ and $dr_2$ against the film and hold it under tension, press it under tension around the large roller R.

XQ. 450. That is, they don't press the film on the roller?

A. Yes.

XQ. 451. They stretch it tight around the roller, don't they?

A. They produce tension, and of course the tension presses the film on the roller.

XQ. 452. Don't those springs produce oscillations?

A. Not necessarily.

XQ. 453. No, not necessarily, of course. But does the patent show any means for preventing their producing oscillations?

A. Under certain conditions oscillations are not a problem at all.

XQ. 454. Does the patent show any means for preventing oscillations due to those springs?

A. I do not assume that any oscillations will be produced. Why should there be a means for preventing them? None are produced.

XQ. 455. I understood you to say a moment ago that they might be produced, but not necessarily.

A. Oscillations will not be produced unless there is some variation in the driving force of a particular frequency. If such variation does not occur, oscillations will not be produced.

XQ. 456. Does the patent say that if the driving force has certain oscillations, there will be oscillations

of those springs which would be harmful, and to prevent them you must do so and so? It gives no such instructions?

A. As far as I remember, the patent does not say anything about oscillations, of the motion of the springs.

XQ. 457. Now, in Figures 5 and 6 of the patent, the idea is, is it not, that during normal running the arm 2 shall not contact with either of the stop pins numbered 5?

A. Yes, the arm 2 remains in a position intermediate to the two stop pins.

XQ. 458. Are there any instructions in the patent as to the size or force of the spring, other than it "can be very feeble, as at constant speed it has to overcome only the losses from friction of the driven part." I am here quoting from page 3, line 78.

A. The strength of the spring is definitely specified as one which is sufficient to produce the torque to carry the film down through the sound mechanism.

XQ. 459. Leaving the arm between the stops 5 and 5, you mean, not touching either?

A. If the spring were not strong enough to do that the arm would of course pass over and hit one of the stops.

XQ. 460. Now, any spring that was of a proper strength to keep the arm in the middle between the stops 5 and 5 in constant running, is the proper spring to use under the instructions of this patent, is it?

A. There is no statement of that character at all in the patent.

XQ. 461. Is there any statement to the contrary?

A. "This spring can be very feeble"—I am reading now from page 3, line 78, and of course one would immediately make a spring which was just strong enough to produce the desired force and no more, be-

cause the advantage of having a feeble spring is here very definitely pointed out.

XQ. 462. If that is done, the thing will work well, will it?

A. If that is done and other factors are correct, then satisfactory operation may be obtained.

XQ. 463. What other factors? That is, what I am getting at is, that the spring may produce oscillations, may it not, if care is not taken to prevent it?

A. There are possibly some structures, incorrectly designed, in which oscillations may be a troublesome factor.

XQ. 464. Does the patent tell you how to design it, so that you shall not get oscillations from this spring action?

A. The patent tells you, of course, to use a very feeble spring, which is a condition very favorable for the elimination of oscillations.

XQ. 465. And if I use a very feeble spring, just strong enough to keep the arm in the midway point between the stops 5 and 5, I will not introduce additional oscillations by reason of the spring?

A. The answer to that question must be tied up with a very definite set of specifications as to the size of the flywheel, the type of the driving mechanism and other factors; and, without such details, I am not in a position to answer you.

XQ. 466. Have you ever tried to build one of these devices with a spring such as shown in the patent Figures 5 and 6?

A. Oh, yes; oh, yes.

XQ. 467. And have you ever tested it to see whether it would introduce oscillations?

A. Yes.

XQ. 468. Work all right?

A. Yes.

XQ. 469. What kind of damping means did you have on it?

A. No damping means on it at all, other than the natural damping of the system.

XQ. 470. And you took care to make that natural damping of the system sufficient to prevent oscillations?

A. We made no special precautions on the damping of the system. There is always friction. If there weren't friction we could have perpetual motion machines.

XQ. 471. If the sound is on an elongated ribbon of inconsiderable mass, uniform motion is desirable, and the problem, if there was any, is the same whether there is only one sound record in the length of the ribbon or a number of sound records side by side on the ribbon, isn't it?

A. I do not know of any equipment today that reproduces two sound records simultaneously, and I do not know what the problem would be in that case.

XQ. 472. Why not reproduce them successively and have the film go round more than once?

A. Have the film go round more than once?

XQ. 473. And the second time project from another part, take off the sound from another portion of the film.

A. The problem is, of course, to have the film or the phonogram carrier pass the translation point at as nearly a constant speed as is possible; in addition to other co-operating features.

XQ. 474. Now, the patent refers to means for supporting and progressing the record ribbon. Do you take it that that implies or instructs that there should be means for supporting and separate means for progressing, or that there should be means which will both support and progress?

A. I do not think that the patent specifies whether it is essential that these means be separate or combined.

XQ. 475. Well, the patent says that there shall be means for supporting and progressing the record from one point to another point, does it not?

A. Will you refer to that statement, Mr. Neave, please, for me?

XQ. 476. Claim 5, for instance, line——

A. Oh, in the claim. I thought you said——

XQ. 477. That is the first place I happened to find it. A combination of means for supporting and progressing the record ribbon from one point to another point. Now refer to Figure 1. What is the one point and what is the other point in Figure 1?

A. The one point, as I understand it, is the point at which the film entered the apparatus, and the other point is the point at which the film leaves the apparatus.

XQ. 478. That is, way down at the lower left-hand side and the lower right-hand side?

A. If there are other supporting members in Figure 1, of course, the two points would be further removed from the rollers $dr_1$ and $dr_2$.

XQ. 479. And still referring to that figure, what is the intermediate part? Intermediate of what?

A. Past an intermediate point at which the record is made on the ribbon in recording or from which the record is taken from the ribbon in reproducing.

XQ. 480. Intermediate of what, the first point and the second point?

A. Somewheres in between the point where the film enters the apparatus and where it leaves the apparatus.

XQ. 481. The record is to be made at the intermediate point. Now, what is it, intermediate between what?

A. Between the point where the film enters the apparatus and where the film leaves the apparatus.

XQ. 482. And in Figure 1 is the optical system intermediate between the point where the film enters the apparatus and where it leaves it?

A. The light is thrown onto the film at a point between the point at which it enters the apparatus and at which it leaves the apparatus.

XQ. 483. And the flywheel $m_2$ in Figure 1, would you say that was adjacent to the intermediate point? Isn't it adjacent to each of the first two points?

A. Beg your pardon?

XQ. 484. Isn't it adjacent to each of the first two points rather than to the intermediate point?

A. Yes; any device may be adjacent to more than one thing. It is certainly adjacent to the intermediate point.

XQ. 485. And in Figure 2 is the flywheel adjacent to the intermediate point?

A. Yes, immediately adjacent.

XQ. 486. What?

A. Immediately adjacent.

XQ. 487. Immediately at, you mean, don't you?

A. Immediately adjacent.

XQ. 488. It is one side of it, isn't it?

A. The film is on—the film is—it does not occupy the same space that the flywheel occupies, so it is merely adjacent.

XQ. 489. Now, the defendants in their apparatus do not use that stationary cylinder with the wide slot in it, as you call it, through which the light passes to the photoelectric cell, do they?

A. I don't think I referred to the slot. It seems to me——

XQ. 490. Well, a wide opening one-sixteenth of an inch thick, or one thirty-second wide?

A. The defendants do not use a cylinder to surround the photoelectric cell.

XQ. 491. And do the defendants use the rollers $dr_1$ and $dr_2$ of Figure 1?

A. In which equipment?

XQ. 492. Any of them that you have before you.

A. Yes, there is a roller shown in Defendants' PS1 sound apparatus.

XQ. 493. Which is the roller?

A. It is not labelled.

XQ. 494. Spring-pressed?

A. There is a spring in combination with this roller.

XQ. 495. And does it press the film against the roller?

A. It does not press continuously. It does press at certain times.

XQ. 496. What do you mean by that: intermittently?

A. It presses the film when a splice passes through. Of course, it has the same effect as the rollers $dr_1$ and $dr_2$, because it produces a seating of the film on the sprocket teeth.

XQ. 497. And $dr_1$ and $dr_2$ press the film closely and firmly against the roller, don't they?

A. They seat the film at the base of the sprocket teeth.

XQ. 498. The patent says that they press the film firmly against the roller, doesn't it?

A. I do not see any statement that they press the film firmly against it. They merely press the film against the carrier roller $r_2$.

XQ. 499. Well, I won't pause to look for it. I got it out of the patent somewhere.

A. I am quoting from page 2, line 3.

XQ. 500. There are some rollers in Figure 4. Those rollers are marked g and e. They press the

film strip firmly against the cylinder, don't they? That is on page 2 of the patent, line 87.

A. Yes, they seat the film at the bottom of the teeth, and by producing a tension on it, press it closely in contact with the roller $dr_1$.

XQ. 501. And in the defendants' device you find no rollers that press the film firmly against the cylinders, do you?

A. Yes.

XQ. 502. You have just said that they did not, that they only press the film against the cylinder when a splice came through, a thicker piece of film?

A. It presses the film against the cylinder due to the tension which the roller exerts on the film. If there is not a tight engagement at the bottom of the teeth, this roller immediately comes into play.

XQ. 503. Because that roller passes the film firmly against the cylinder?

A. In my estimation the effect is such.

XQ. 504. Don't you know that that only causes the sprockets to enter the holes in the film?

A. And in doing so, to hold the film down against the cylinder.

XQ. 505. Have you ever examined that to find out whether it presses the film against the cylinder or not?

A. I understand the defendants' instructions say it should be adjusted, as all sprockets are and, in this case, it allows a single layer of film to pass through the bottom of the teeth without rotating the sprocket. Just as soon as that close engagement is departed from, this roller comes into use.

XQ. 506. The defendants do not use the overhang, do they, of Figures 3, 4 and 6?

A. In PS1 and PS16 the overhang of the film is not used.

XQ. 507. And we are talking about defendants' apparatus that is here charged to be an infringement?

A. I did not understand that. I understood you to ask me whether the defendants use the overhang film, and my answer to that is yes.

XQ. 508. In the apparatus here charged to be an infringement?

A. Not in the apparatus directly in this suit.

XQ. 509. Or indirectly? In none of the apparatus in this suit?

A. In none of the apparatus in this suit.

XQ. 510. I am a little confused, Professor, as to what claims you thought read on defendants' structures, because I thought you made a little change or some modification the second time you were recalled: am I right in my understanding that you say that Claim 5 reads on Figures 1, 3, 4, 5 and 6?

A. Without referring to my testimony on that, Mr. Neave, I cannot answer you positively. I have noted on my notes here that Claim 5 applies to Figures 1, 3 and 5. Figures 4 and 6 are other views.

XQ. 511. Why in your opinion doesn't it apply to Figure 2?

A. Because Claim 5, as one of its elements, specifies "a toothed cylinder over a portion of which the ribbon passes adjacent to said intermediate point, the teeth of said cylinder engaging the perforation of the ribbon, a flywheel associate with said cylinder, and means for rotating said cylinder, under control of said flywheel, at uniform speed." Now, in Figure 2, I do not see any toothed cylinder with the flywheel for maintaining the speed constant.

XQ. 512. And is that the same reason why you did not say that Claim 7 applied to Figure 2?

A. I do not think the reason there has anything to do with it. The structures are different.

XQ. 513. What was the reason?

A. What was the reason for what?

XQ. 514. Why you did not apply Claim 7 to Figure 2?

A. Because Claim 7 specifies a resilient connection.

XQ. 515. Now, look at Claim 9. You applied that to Figures 2, 3 and 6. Why did you not apply that to Figure 1?

A. I personally felt that Claim 9 should be applied to Figure 1, because there is a very definite arcuate bending of the film at the point of translation, in my estimation. But it is not illustrated as clearly as it is in the other figures and, to avoid any controversy on the matter, I did not so include it.

XQ. 516. You say you personally felt. Who disagreed with you?

A. Who disagreed with me?

XQ. 517. Yes.

A. We have discussed these things informally.

XQ. 518. Not with me. Whom did you discuss it with?

A. Not with you, of course. With my associates.

XQ. 519. The counsel appearing for the plaintiffs, you mean?

A. No. There are a number of us who are engaged in discussing this matter.

XQ. 520. Including the counsel for the plaintiffs?

A. I have discussed this matter with counsel for the plaintiffs at various times.

XQ. 521. As I understand, you applied Claim 17 to Figures 1 and 2 only. Why didn't you apply it to the other figures?

A. Because I do not believe that Claim 17 reads on the other figures.

XQ. 522. Why not? That is what I am trying to ask.

A. On account of the further limitation, for one reason, which was imposed upon the claim by the disclaimer.

XQ. 523. What was that?

A. That the sprocket engaging the carrier forms a part of the carrier progressing means, and a substantial portion of the periphery of the cylinder is in contact with the carrier in its travel from the intermediate point to said sprocket. The broadest interpretation of Claim 17 might be considered as reading on some of these other figures. I did not mean by eliminating it in my list that it did not read on them, but certainly other figures seem to show it more clearly.

XQ. 524. Is it your opinion, personal or otherwise, that Claim 17 does not read on the figures other than 1 and 2?

A. I could conceive that Claim 17 would read on these other figures, yes.

XQ. 525. Do you think it does?

A. I think that it may be read on these other figures.

XQ. 526. Do you think that it does? You had no hesitancy in expressing your opinion as to the meaning of the claims.

A. If you will give me a moment to study it a little more in detail, please.

XQ. 527. Certainly.

A. I feel that interpreting the contact with the carrier from the intermediate point to said sprocket, being between the translation point and the sprocket, would rather remotely read on the other two figures, and I think that perhaps it does not read on Figures 3 and 4.

XQ. 528. Are you taking the disclaimer into consideration there?

A. In this discussion, yes.

XQ. 529. Now, disregarding the disclaimer. Supposing the disclaimer had never been filed; would your view be different?

A. Without the limitation of the disclaimer, this claim might be read on some of the other figures, yes.

XQ. 530. If you rely upon friction in a machine, the ordinary friction of the bearings and moving parts to give you the damping so that the spring connecting the shaft with the flywheel did not introduce oscillations, are you not relying upon something which is very irregular in amount and so irregular that it might sometimes provide effective damping as well as not?

A. Frictional losses today in rotating machinery are fairly constant. There should be no reason why they should vary over very wide ranges, no.

XQ. 531. There is a statement in the first column of the patent about cylinders and discs being used as sound record carriers, and it says that they are of considerable momentum, which would equalize any small irregularities in speed. Is it your view that phonographs with cylinders or disc records would not operate satisfactorily if the records were light? That is what this patent seems to mean.

A. If the records had no inertia whatsoever, there would be of course no stabilizing effect due to their motions, and the smaller the inertia of the record the less would be the stabilizing effect.

XQ. 532. So far as I have seen, all disc records rest upon a turntable that revolves and revolves with them. There is a mass there, is there not?

A. Yes. This patent definitely speaks of phonograph carriers.

XQ. 534. What if it does? The record carrier, it says, consists of a cylinder or disc possessing a somewhat considerable momentum. Speaking of the record carrier, the word "carrier," as used in this patent, seems to mean the thing upon which the sound itself

is impressed. That is the way it is used in the third line of the patent. When you have a disc which carries the sound isn't that disc always placed on a metal turntable?

A. There is a revolving carrier table which tends to revolve the disc.

XQ. 535. And that is of considerable weight?

A. Yes.

XQ. 536. That has a flywheel effect, hasn't it?

A. That has some effect in smoothing out slight irregularities, such as might be important with the poor type of recording there employed.

XQ. 537. And the weight of that metal support in the form of a disc is very considerable in comparison with the weight of the disc itself on which the record is?

A. Not always. I have seen some machines that had thin sheet metal turntables.

XQ. 538. How heavy do you think a disc is that has the record on it? You have seen some very light ones, haven't you, and some thick ones?

A. Yes, I have seen some light ones and some thick ones.

XQ. 539. Have you ever seen one of those records ten-thousandths of an inch thick?

A. Ten one-thousandths of an inch thick?

XQ. 540. It is the same thing, isn't it, ten-thousandths?

A. Ten one-thousandths?

XQ. 541. Ten one-thousandths.

A. Flat disc record of ten one-thousandths of an inch in thickness?

XQ. 542. Yes.

A. I don't remember having seen one of that thickness, although of course there are certain cheap records which are stamped on paper and which probably are of approximately that thickness, although I cannot

state definitely. The so-called "Hit of the Week" records are approximately of that thickness.

XQ. 543. You say that you have tested Figure 6. That is the one that has a spring on it between the driving shaft arm and the flywheel, and you said that the friction acted as sufficient damping. Friction where, referring to the figure?

A. I did not intend to admit that there was any trouble with oscillations, Mr. Neave. I have not noticed any difficulty with oscillations. I think you questioned me as to what would happen should oscillations occur, and how they could be eliminated.

XQ. 544. I thought you said that the friction afforded sufficient damping so that there would be no oscillations.

A. You asked me what would happen should oscillations occur.

XQ. 545. The spring is the source of oscillations.

A. I cannot agree with you. The spring cannot set up any motion itself.

XQ. 546. Here you have a spring going out there. Little variations in the spring of the drive, and that begins to jiggle that spring, doesn't it?

A. Variations in the speed of the drive jiggle the spring?

XQ. 547. The variations in the drive act on the spring to extend it or not, to pull it out so much, don't they?

A. That is the function.

XQ. 548. And that sets up a vibration in the spring, doesn't it?

A. Not necessarily.

XQ. 549. Does that make the whole thing an oscillatory system?

A. No.

XQ. 550. Why doesn't it?

I thought you told me it was because you had friction in the parts.

A. Perhaps we are not in agreement on the definition of the words "oscillatory system." If by "oscillatory system" you mean any elastic system that may be compressed and elongated, any spring of course comes under that definition. If you mean a system in which the mass and the spring react together so that you produce abnormally large variations in the motion, that is another matter.

XQ. 551. My information is that the spring in Figure 6 does produce these variations in the motion.

A. I do not see how the spring alone could possibly do so.

XQ. 552. It could not, of course, but it could, according to my view, in connection with the little changes in the variations in the speed of the shaft. Then the flywheel and the spring come into oscillation with each other and give you a great deal more oscillations than if you had not used any flywheel at all.

A. I do not agree with your statement. I have tried it out and did not get any such results.

XQ. 553. Did you build the apparatus yourself?

A. I did not.

XQ. 554. And this apparatus that you say you saw, what did it contain in addition to what was in Figures 5 and 6?

A. Nothing.

XQ. 555. Just what was shown in Figures 5 and 6?

A. Yes.

XQ. 556. Was it driving a film?

A. Yes.

XQ. 557. And the film was just as shown in Figures 5 and 6?

A. Very closely.

XQ. 559. How was the film hitched up? Did it go to sprocket wheels? It was not just standing out

in the air or in space as shown in Figure 6? How did you support the film in that apparatus you saw?

A. Wrapped around the sprocket.

XQ. 560. How long was the film?

A. The length of the film? I cannot tell you the exact length. I have seen tested a number of pieces of film of considerable length. Several hundred feet.

XQ. 561. How did the film get to the point as shown in Figure 6? Did it come from a projector machine?

A. Yes.

XQ. 562. What other apparatus did you use? First you tell me you used nothing but what was shown in Figure 6. Now you say you had something else.

A. A driving motor, and photoelectric cell, and other accessory apparatus which were not shown in this case.

XQ. 563. Let us see what you had. You had a projector, did you?

A. Yes.

XQ. 564. Then you had a sound box or sound head below the projector head?

A. Yes.

XQ. 565. And that was built just as shown in Figure 6?

A. According to the specification and Figure 6.

XQ. 566. And in addition to that there were the ordinary rollers and sprockets and so forth that are in a sound head?

A. Yes.

XQ. 567. What was the form of spring you used there?

A. Very much as shown. A small coil spring.

XQ. 568. And then there was an arm extending out as shown in Figure 6 with a spring attached to it?

A. Yes.

XQ. 569. Where did you get the apparatus? Who made that apparatus that you had?

A. Some experimental apparatus that was built in the course of our investigation of this work.

RE-DIRECT EXAMINATION.

By MR. WARD:

RDQ. 570. You were referred by Mr. Neave, or asked by Mr. Neave, what the patent taught in regard to the size of the flywheel to be used according to the information of the patent, and I think you referred to the relative size of the flywheel in the drawings with reference to sprocket teeth, as I remember it, or the sprocket holes in the film. Will you please look at the specification of the patent at page 1, commencing at line 48, and state what the specification there teaches with regard to the requirements of the flywheel.

A. Beginning at line 42:

(Reading): "According to the present invention, this drawback which attaches to all hitherto known propulsion mechanisms for linear phonogram records is obviated by the arrangement, that the light sound record has given to it at the controlling point the property of a weighty mass."

This describes in no uncertain terms that the flywheel must have the effect of a weighty mass.

RDQ. 571. Now, will you please refer to page 3, commencing at line 66, which is the first line on the second column, and state what the specification in this paragraph teaches. Does that give any indication as to the character of the flywheel with respect to relative speeds or different speeds? Does it teach anything at all?

A. Yes. This statement shows that under certain conditions the connection to the flywheel is rigid, that the flywheel may be so large as to be unwieldy to in-

corporate in a machine. "If the driving shaft of the tone film revolves with a low number of revolutions and if a rigid drive is used, the circumferential speed of flywheels which can be practically utilized will, under certain conditions, not be sufficient for compensating the speed of fluctuation." Indicating that under certain conditions, very large flywheels would be required and should be used. And then the patent goes on to state that by the use of the elastic coupling, in many cases the size of the flywheel can be cut down to be more nearly better accommodated in the apparatus.

RDQ. 572. Can you state whether the flywheels are shown consistently of substantially larger size than the cylinders or sprockets or smooth rollers over which the film passes, or do the relative proportions vary considerably?

A. They are consistently larger than the rollers over which the film is caused to pass.

RDQ. 573. You have stated that the patent teaches the use of a so-called optical slit, that is, where the light is projected in a fine line transversely of the film, and Mr. Neave sought to have you testify that in Figure 1 of the patent drawings there was shown a physical slit. Now, will you state whether the patent teaches anywhere the use of this physical slit up against the film?

A. The patent does not teach the use of a physical slit in contact with the film. This opening in Figure 1, it will be noted, is many times as wide as the light beam, which is passing through it, and could obviously have no effect in limiting the size of the light beam.

RDQ. 574. Is the physical slit used against the film in conjunction with the optical slit?

A. Not to my knowledge.

RDQ. 575. You were questioned about wherein the patent taught the use of the optical slit, and I think

you referred to one point in the patent. I wish you would look at page 2, lines 42 to 45.

A. I think I read that, beginning line 42:

> "The light rays required for the illumination or the transmission of light through the film are thrown upon the film in the form of a narrow line by means of the objective o."

RDQ. 576. Now, will you refer to page 3, lines 33 to 42?

A. "The light collected by the object glass o to a narrow line, comes from a suitable known means or source of light projection so arranged as indicated for example by the dotted lines in Figs. 3 and 4, that the converged narrow line of light is substantially focussed or impinges upon the area of translation t on the film as a line running transversely of the direction of movement of the film."

RDQ. 577. What do you understand that to describe? You had something to say about there would be a line of light which the object glass projected to a narrower line.

A. I understand that there is some source of light behind the object glass, which is reduced in size and brought to a focus on the surface of the film to a narrow fine transverse line.

RDQ. 578. And with regard to the photoelectric cell, I think you said something about that there were prior references by these patentees of the use of the photo cell for sound reproduction. You meant prior applications for patents?

A. Prior applications. I should not have said "references."

RDQ. 579. When you said, in answer to one of Mr. Neave's questions that the device you tried out with the spring drive without damping means or with-

out special damping means, in substance, had nothing else than Figures 5 and 6, you did not mean that there was no projection head or other apparatus in conjunction with it? You simply meant so far as concerned the spring drive and stop means, that is all the device had?

A. I think I testified that there was a projection head or picture head used in connection with this apparatus.

RDQ. 580. And the whole sound head?

A. A complete sound picture apparatus rather than one part.

RDQ. 581. I believe you said in substance that with reference to the application of Claim 17 to the patent drawings, that you could conceive of the possible application of the claim to Figures 3 and 4. Was that what you said, or just what did you say about that? I want to refer you to that question.

A. I think the bearing on Figures 3 and 4 particularly with the disclaimer is rather remote.

RDQ. 582. That is, just as the drawings are there shown, it is remote?

A. Yes.

RDQ. 583. Without any additions to the drawings?

A. Yes.

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JOSEF ENGL, recalled as a witness, testified further as follows:

RE-DIRECT EXAMINATION.

By MR. WARD:

RDQ. 872. Dr. Engl, Mr. Joy testified that you had built in Berlin, I think he said in 1929, a sound on film sound picture machine which embodied the movement of Figure 2 of the patent, using a small roller on the flywheel shaft. Is that correct or incorrect?

A. Yes, that is true. I constructed a machine working after the principle shown in Figure 2 of the patent, in the year 1928, and the machine was completed in 1929 and has been used since that time for very truthful production of records, testing whether records were recorded with constant speed and so on. The construction was—I go into details—the following one: a smooth roller, connected rigidly with a very heavy flywheel of large dimensions; film run over the smooth roller, it was pressed against the roller by means of pressure rollers.

RDQ. 873. Were those pressure rollers spring-pressed pressure rollers?

A. Spring-pressed pressure rollers.

RDQ. 874. And how was the film progressed or passed along the sound head?

A. There was a feeding sprocket wheel and a taking-up sprocket wheel both geared together and driven by a driving motor. The flywheel was brought in motion by the film itself.

RDQ. 875. That is, the sprocket drove the film and the film passing over the smooth roller drove the flywheel?

A. Exactly.

RDQ. 876. Did anyone else besides yourself, to your knowledge, build sound on film sound picture machines in Germany using this Figure 2 movement, and if so, who?

A. Yes. Yes, I know that the Tobis people built a——

RDQ. 877. Will you give the full name of that Tobis Company?

A. That full name is Tonbild Syndikat, A. G. I know that the Tobis people built a large lot of reproducing outfits, using this principle of a smooth roller connected on the same shaft with a flywheel, and pres-

sure rollers—spring-pressed pressure rollers-giving—pressing the film against the smooth roller.

RDQ. 878. Against the smooth roller, did you say?

A. The smooth roller, yes.

RDQ. 879. And did they also have sprockets for driving the film?

A. Yes, of course they had sprockets feeding the film to the translating point on the smooth roller and feeding it from this point to the taking-up reel.

RDQ. 880. And what drove the flywheel?

A. The flywheel was driven by the film.

RDQ. 881. Can you state when they built these machines with this movement in them?

A. They built those machines during the course of the years 1929 and 1930.

RDQ. 882. And was it an independent construction of your patents or was it built with some relation to your patents?

A. It was built under the specification of the patent here in suit.

RDQ. 883. I mean did they have any rights under your patents?

A. Yes, they acquired a license under this patent from the Tri-Ergon, A. G., Zurich.

RDQ. 884. And these machines were built under the license?

A. Yes.

RDQ. 885. I hand you a device and ask you if you know what that is.

A. That is one of the flywheels used in the lot of twenty-five which has been mentioned quite a number of times here now in the testimony.

RDQ. 886. That is, it is one of the flywheels used on one of your Tri-Ergon machines which constituted one of that lot of twenty-five you testified about?

A. Exactly. A flywheel of the same shape and design I brought over in the machine in the years 1926 and 1927.

Mr. Ward: I offer that in evidence as Plaintiffs' Exhibit No. 33.

(The flywheel, one of the lot of twenty-five, of the same shape and design as brought over by Dr. Engl in 1926-1927, was received in evidence, and marked Plaintiffs' Exhibit 33.)

Re-Cross-Examination.

By Mr. Neave:

RXQ. 887. Mr. Ward began questioning you this afternoon, as I understand it, about a talking motion picture machine which you built in Germany in 1928 and 1929. Was that a talking motion picture machine?

A. Yes. I wouldn't call it a motion picture machine, because there was no facility for reproducing pictures with this type of machine.

RXQ. 888. It was just for sound?

A. It was just a sound laboratory device for testing.

RXQ. 889. You were familiar with moving picture machines at that time, weren't you?

A. Yes, I am.

RXQ. 890. And you knew of the existence of talking picture machines from films before you and your associates made the invention here?

A. Yes, I knew of the experiments which had been made, for instance by Ruhmer.

RXQ. 891. No, didn't you know the commercial machines, you knew of the Krupp-Ernemann machines, didn't you? I think that is the name of it.

A. You are speaking now of picture projector machines?

RXQ. 892. Picture projector machines entirely.

A. Oh, yes, I knew of that.

RXQ. 893. You knew of their existence before you and your associates made your inventions?

A. Yes.

RXQ. 894. And the motion picture projector was no part of the invention of you and your associates?

A. No.

RXQ. 895. Will you look at this projector we have here. Do you recognize that as a Krupp-Ernemann projector? Look at it and see if it is.

A. I wouldn't recognize it as a Krupp-Ernemann projector. It seems to me, as far as I can decide, an old Ernemann projector.

RXQ. 896. It is marked "Ernemann II"?

A. Yes.

RXQ. 897. What does that mean, an earlier date?

A. Yes, as far as I know it means an earlier date. The firm Ernemann was an independent firm for some time, then it was combined with Krupp—rather, Krupp bought it.

RXQ. 898. Did you know of this Ernemann projector before you and your associates made your invention?

A. Yes. Anyway, I wouldn't say that I just knew of all the details of this specific construction.

RXQ. 899. Oh, no. But this Ernemann machine before you has a flywheel there acting on a shaft, that imparts an intermittent motion for the projecting of the film, hasn't it?

A. Yes, there is a small flywheel on this shaft.

RXQ. 900. And you knew of Ernemann machines or the Krupp-Ernemann machines having flywheels of this character on a shaft, imparting the intermittent motion for the projector, before you made your inventions, didn't you?

A. I wouldn't say that. I would say that quite generally I knew on shafts the intermittent movement used flywheels to overcome the danger of the dead center position.

RXQ. 901. You speak of this as a small flywheel; but of course it worked a good deal faster than your sound flywheels, didn't it?

A. But you have not to forget that the whole structure here is a very heavy one.

RXQ. 902. I know that.

A. I mean, it is a very small flywheel compared with all the other parts of the mechanism.

RXQ. 903. But it runs at a very high speed in comparison with your mechanism, doesn't it?

A. Now let me see at which speed it runs.

RXQ. 904. Well, it runs on a shaft which causes the intermittent movement of the film for the projection?

A. Yes, it runs on a shaft which runs, let us assume, twenty-four revolutions per second, yes.

RXQ. 905. Which is much higher than yours?

A. Yes, it is several times more.

RXQ. 906. So this is the kind of a thing you knew of before you and your associates made your inventions, so far as the flywheel action is concerned, on the projector?

A. On the picture.

MR. NEAVE: On the picture projector.

May I have that marked for identification, please?

(Propector, "Ernemann II," was marked Defendants' Exhibit 28 for Identification.)

RXQ. 907. Have you any idea what the moment of inertia of the flywheel was on your 1928 machine?

A. No, I couldn't give you exactly.

RXQ. 908. Was this flywheel that you produced here just like the flywheels you used on your 1928 machine?

A. Of which machine are you speaking now, Mr. Neave?

RXQ. 909. The machine that you testified that you made in 1928, or 1929?

A. No, the machine that I made in 1928 or 1929 had a flywheel of larger diameter (indicating Plaintiffs' Exhibit No. 33, flywheel).

RXQ. 910. Larger diameter; and what width—thickness?

A. The width was about the same.

RXQ. 911. Do you know what its weight and diameter and width were?

A. I couldn't tell you anything about the weight, but I can give you the figures about the dimensions. I think that the diameter was about 2.5 times larger.

RXQ. 912. Larger than this that has just been offered and that Mr. Ward offered in evidence? (Indicating Plaintiffs' Exhibit No. 33).

A. Yes, sir.

RXQ. 913. What was the speed of revolution of that shaft, do you know?

A. The speed of revolution of that shaft was either three or four per second. I couldn't tell you exactly.

RXQ. 914. Does that mean your sound film was traveling about 75 feet a minute?

A. About, I think, 90 feet a minute; standard film speed.

RXQ. 915. Did you ever use sound film which you progressed at the rate of 75 feet per minute?

A. I certainly have, in the course of my experiments.

RXQ. 916. Those were your first experiments?

A. Pardon me?

RXQ. 917. Those were your first experiments, were they?

A. Which?

RXQ. 918. When you used 75 feet per minute for the speed of the film?

A. Oh, no, we used smaller speed, we used higher speed. I might have made a number of experiments with smaller speed in the years after.

RXQ. 919. When you made your demonstrations in 1923 you were using a speed of 75 feet per minute, weren't you?

A. Now let me see. Twenty-four pictures per second are, as far as I remember, 90 feet per minute.

RXQ. 920. 1923.

A. I am not very good in figuring, you know. I have to take a pencil and paper.

RXQ. 921. Take all the pencils and papers you want.

A. Then I have to ask you another figure too, that is the length—rather, the height of one frame. What is one frame?

RXQ. 922. Whatever you used.

A. Pardon me. The standard frame. I have to figure; not in my mind, I can't.

RXQ. 923. Three-quarters of an inch of the standard frame.

A. Three-quarters of an inch is one frame. And 24 frames are, just (witness calculates with pencil and paper) 16 inches; that is one and a half feet, is it not, I think?

RXQ. 924. No.

A. No, let me see. Sixteen inches are less than that.

RXQ. 925. One and a third foot.

A. Let me see. I think that is not sixteen inches, but eighteen inches. Yes, it is eighteen inches. One and a half foot. And in sixty seconds then you have

sixty foot and 50 per cent. of that, is 90 feet per minute. That is the standard speed of recording and reproducing.

RXQ. 926. Well, is that the speed that you used in your demonstrations in 1923?

A. Yes, we did.

RXQ. 927. I think you said that the flywheel you used in 1928 and 1929, while larger than the one that has just been offered in evidence here by the plaintiff, was of about the same thickness?

A. Yes.

RE-DIRECT EXAMINATION.

By MR. WARD:

RDQ. 928. Doctor Engl, will you look at this flywheel on Defendants' Exhibit No. 28, and state what that flywheel which drives the intermittent motion is for?

A. The object of the intermittent movement is to be at rest during a certain part of one period and to be moved very quickly during the remaining part of that period. And that means that it has to be accelerated very fast and then come to a stand, a still position with a very fast deceleration—I don't know whether the word "deceleration" is right.

RDQ. 929. It is all right, yes.

A. Retardation. Now, these changes in speed have to be produced by a rotating shaft; because we drive the whole thing by a rotating motor, that means that the load on this rotating shaft is varying intensely, and to overcome these intense variations in load, this flywheel is put on the shaft. And I would like to add here that without this flywheel, if there is a very small moment of inertia in this shaft, you are under danger of having that in what I called, a few days ago, the dead center position, so that the whole mechanism might be locked and injured.

RE-CROSS-EXAMINATION.

By MR. NEAVE:

RXQ. 930. In each revolution in this projector, of the constantly moving shaft, the star-wheel—which moves intermittently—is shifted once, isn't it?

A. Yes.

RXQ. 931. For each revolution?

A. Yes. Each revolution.

RXQ. 932. So that every time the constantly rotating shaft that has the flywheel on it meets that star-wheel, an extra load is put on the constantly moving shaft, isn't it?

A. Yes, a load is put on.

RXQ. 933. Yes, an extra load?

A. Yes.

RXQ. 934. So that it slows down that constantly moving shaft, doesn't it, at the time when that extra load goes on?

A. That depends on the ratio of the extra load, of course.

RXQ. 935. Well, the amount of the extra load determines how much the shaft is slowed down, doesn't it, if there is an extra load put on it?

A. Yes.

RXQ. 936. And when you put on an extra load on the shaft, it tends to slow down the speed of revolution of the shaft?

A. Yes, exactly.

RXQ. 937. Now, it does not slow down as much with the flywheel on as though the flywheel were off, does it—because when the speed of the shaft slows down the energy that is stored in the flywheel is delivered to the shaft, so as to force it on, so that it makes the slowing down of the speed less than it otherwise would be? Isn't that the function of the flywheel.

A. Yes. You can give this interpretation.

MR. NEAVE: All right, that is all.

MR. WARD: Your Honor, if you have no objection to it, I would like you to place the statement on the record, if you recall the incident, as to the fact that when you were asked to turn the crank handle of the Simplex machine, Defendants' Exhibit—what is it, Mr. Ashton—with the flywheel removed from it, your Honor observed that it turned over much harder than it did before the flywheel was removed when your Honor cranked it.

The fact is that your Honor was asked to try that, but it does not appear on the record, no one has testified, that it turned over any harder. If your Honor has not any objection to indicating your feeling.

THE COURT: Any objection, Mr. Neave?

MR. NEAVE: No. I think that is right. I think it turned over harder. But also, it did not turn over so evenly; you kept meeting bumps on it.

MR. WARD: I am willing to have stated what your Honor found to be the case.

THE COURT: I found that it turned over harder and more unevenly.

MR. NEAVE: That is my understanding.

MR. WARD: May it also appear on the record at this time, as a statement for the record, rather than just a statement of counsel, that Mr. Neave has already made, that Dr. Wente and Mr. Ashton were given an opportunity to go over Dr. Engl's notebook to which he referred in giving his testimony, and they spent about an hour and a half studying it.

MR. NEAVE: That is right.

MR. HASELTON: Your Honor, I have Senate Document, Volume VI, 67th Congress, First Session, and I offer in evidence page 1 of that volume, which deals with the transmission of the Treaty of Berlin to the United States Senate; I offer that as Exhibit No. 34-A.

(Page 1, Volume VI, Senate Document, First Session, 67th Congress, received in evidence and marked Plaintiffs' Exhibit 34-A.)

MR. HASELTON: I also offer in evidence pages 11 to the end of this volume, which comprise certain sections of the Treaty of Versailles; I offer that to be Defendants' Exhibit 34-B.

(Received in evidence and marked Plaintiffs' Exhibit 34-B.)

MR. HASELTON: I have here the Government publication entitled "Treaty Series, No. 658," which I offer in evidence as Plaintiffs' Exhibit 34-C.

(Received in evidence and marked Plaintiffs' Exhibit 34-C.)

MR. HASELTON: I have here Congressional Record, Volume 61, No. 131, of 1921, pages 7113-14-15-16; 7121, 7122 and 7173, which I offer in evidence as Plaintiffs' Exhibit 34-D.

MR. NEAVE: I have no objection to that in so far as it is offered just to show the ratification of the treaty. If it is offered to show what each of the Congressmen said at that time, I object to it, because it is immaterial what the Congressmen said at that time.

MR. HASELTON: Your Honor, it is offered to show that and also to show that certain amendments were proposed to the Treaty of Berlin,

which were not ratified. I think it has been held in a number of decisions that such proposals can be used to determine the proper interpretation of the treaty as ratified.

MR. NEAVE: Well, I object to that.

THE COURT: You may have a decision of that kind, but I cannot understand that to be the law. A Senator might propose anything.

MR. WARD: Your Honor, does not the manner in which the treaty is considered by Congress show what they had in mind in adopting or rejecting a treaty? Those discussions in Congress are frequently referred to to show what Congress intended either by the rejection or adoption of a treaty. I think your Honor will find that to be the case. And that is all we use this for.

MR. NEAVE: Your Honor, to shorten things, I suggest that my objection be noted and that you reserve your ruling on it.

THE COURT: Yes, I think that is probably the thing to do now.

Very well, gentlemen.

MR. HASELTON: Then I offer this group of Congressional Record pages as Plaintiffs' Exhibit 34-D.

(Pages 7113, 7114, 7115, 7116, 7121, 7122 and 7173 of Congressional Record, Volume 61, No. 131, received in evidence and marked Plaintiffs' Exhibit 34-D.)

MR. NEAVE: Does that close your case, Mr. Ward?

MR. WARD: Yes.

MR. NEAVE: I offer in evidence the sketch which was marked Exhibit A for Identification and

the sketch which was marked Exhibit B for Identification. They can be marked Defendants' Exhibits Nos. 29 and 30.

(Received in evidence and marked Defendants' Exhibits 29 and 30.)

MR. NEAVE: And I offer in evidence the Ernemann projector, which has just been shown to Mr. Engl, and which was marked Defendants' Exhibit 28 for Identification.

(Received in evidence and marked Defendants' Exhibit 28.)

MR. NEAVE: I would also like to state for the purposes of the record that Mr. Ward last Friday, I believe it was, asked if we would state to him which prior uses we were going to rely upon. We tried to find him Friday evening and could not. But the list of prior uses was delivered to his associate, Mr. Joy, on Saturday morning, who said he would deliver them to Mr. Ward.

In order to shorten matters and make it unnecessary to call one witness, the parties have agreed as follows:

First, that if Mr. George K. Thompson were recalled as a witness on behalf of the defendants he would further testify that the Watson cylinder sound record, Defendants' Exhibit 25 for Identification, was obtained by him during the trial of this case from the museum of the Bell Telephone Laboratories, at 463 West Street, New York City; that he had the record placed in the museum in 1926 and it has been there until brought to Scranton and produced here; that the record is one of the records which was used in exhibiting the Watson talking picture at the Panama-Pacific Exposition at San Francisco, California, in 1915; that it

was returned to him at the conclusion of the witness Hammond's tour of the Pacific Coast cities, in 1916; that it was thereafter used in some of the exhibitions of the Watson talking picture in the East in 1916 to 1924. Paragraph 2.

Second: That the cylinder sound record, Defendants' Exhibit 26 for Identification, entitled "Edison's Minstrels," and the Edison Kinetophone, Defendants' Exhibit 11, were recently obtained by him from the plant of Thomas A. Edison, Inc., at Orange, New Jersey.

I offer in evidence as Defendants' Exhibit 25 the Watson record which we previously marked Defendants' Exhibit 25 for Identification.

(Received in evidence and marked Defendants' Exhibit 25.)

Mr. Neave: And I offer in evidence as Defendants' Exhibit 26, the "Edison Minstrels" record, which was previously marked Exhibit 26 for Identification.

(Received in evidence and marked Defendants' Exhibit 26.)

Mr Neave: It is agreed that at the conclusion of this trial these records may be returned to the museum of the Bell Telephone Laboratories in New York City, to be produced, if requested, at any further hearings of this case, and also to be produced at the request of the plaintiffs' counsel for photographing and examination in the presence of defendants' counsel.

ANTHONY J. WEBBER, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live in Bloomfield, New Jersey. I was first connected with the phonograph business in 1908. At that time I went to work for the National Phonograph Company, which at that time was part of the Edison industries. That company later became Thomas A. Edison, Inc. I remained in Orange about a year and a half. I worked in various departments over in Orange, more or less to familiarize myself with the manufacture and constructions of phonographs. At the time I entered there it was with the understanding that I was to go to the recording laboratories after I was qualified. The recording laboratory was at 79 Fifth Avenue, New York City, at that time. I worked in the recording laboratory. The work I did there was recording commercial and amusement records, and experimental work. That is, recording Edison sound records, sound records for the market, as we called them, for the public's amusement for the Edison phonograph. I was employed in the recording work until November, 1928. Thomas A. Edison, Inc., is not still recording phonograph records for the market. I believe they stopped in 1931.

This machine happens to be an old Edison cylinder, Triumph model reproducing machine. I first saw this particular machine when I first went to work for Edison, in the recording laboratory there in New York. I saw the machine operated at the recording laboratory in New York and I operated it many times myself. This machine was used at times for recording records there; the way it is set up now it is for reproducing records. It can be either a recording ma-

chine or a reproducing machine, by changing the small arm on there, that carrier arm. It was a reproducing machine when I saw it at the Edison Company.

I acquired this machine from the widow of an associate that I worked with all the while I was at the studio. My associate's name was Mr. Getcliffe, Harry Getcliffe. The name of the person that I obtained it from was Harry Getcliffe, Mr. Getcliffe's son I obtained it from; but the man that I knew that had taken the machine or had the machine was his father, Mr. Getcliffe. Mr. Getcliffe, Sr., was a librarian at the Edison recording studio in New York. I know how Mr. Getcliffe, Sr., acquired this machine. I remember it very well. Around 1916 or 1917 the direct recording of cylinders was discontinued in New York, and the work was transferred to Orange, where they transferred them from the disc records to cylinders. Therefore, we had no more use for the cylinder records at New York, or, that is, for a limited number of the machines at New York, and some of the older worn out machines were distributed among any of the boys that cared to take them home. And this machine, being closely associated with Mr. Getcliffe for a good many years there, I recall him sending it home with an express company. There are marks on this machine which could cause me to recognize it. This word "Wang" in here. That refers to a man named Wangerman. W-a-n-g-e-r-m-a-n, or double-n, who was also a former employee of the Edison interests. We probably had ten to twelve machines like this machine, which is marked for identification as Defendants' Exhibit 31, at the Edison Company New York laboratory. I would say fifty to sixty on cylinders when we were running, were recorded a month at the New York studio.

For recording there was a different type of arm than this on the machine. For reproducing, the wax

cylinder, after it had been recorded, was taken into the test room, where the critics, secretary or librarian, would take it on this mandrel, close this gate, and with a suitable lightweight reproducer, he would start the machine in motion, play it for the critics and the talent who judged their work. The type of power used in the machine is a conventional spring motor. It is under the top plate; it is suspended to it with springs. It was connected to the mandrel shaft through a belt, a light leather belt.

Machines like this were also used for recording. For recording purposes this particular arm here, this casting, was removed, and another arm substituted, that fed across in exactly the same manner at the same rate of speed. Out here there was a trunnion mounted. The recorder slipped into the trunnion, which had centers here, which permitted it to lightly float on the wax. The horn extending out from the front of the machine.

(The witness opened up the machine so that you can see the motor.)

The spring motor now on the machine is not the same one that was in it when I received it from Mr. Getcliffe. It is exactly the same type of motor. The motor which I have here is the motor which was in the machine. That is the old motor.

Mr. Ashton: I ask that the separate motor be marked for identification as Defendants' Exhibit No. 32.

As to why I replaced the motor in the machine, at the time that I obtained this machine from Mr. Getcliffe it had been out of use, in fact, stored away in the cellar for so long that it was a pretty sad looking affair; so I first cleaned it up and, on trying to wind it to make it operate, I found that not only was

there a casting broke in there, but a spring in one of the barrels was broke. I refer to the casting on this end. I wired it here to keep it from falling down and breaking any more. There is the piece of casting that broke off. I at first tried to make a repair on that casting, and then on winding it found that the spring inside was broken, too. So I substituted a spring motor that I had, which was of the same type and the same period. The motor that is now in the machine is one that I sent home or carried home at the time we discontinued the cylinder records in New York—manufacturing cylinder records in New York. That was 1916 or 1917. The belt which is now on the machine is not the one that was on the machine when I received it from Mr. Getcliffe. The belt which you hand me is the belt that was on the machine when I got the machine from Mr. Getcliffe.

MR. ASHTON: I ask that the belt referred to by the witness be marked for identification as Defendants' Exhibit 33.

I made the belt that is now on the machine. I made many belts at the Edison Company. The belt now on the machine compares with what this belt, Exhibit 33 for Identification, probably was originally. The belt on the machine is about as near as you can get to the belts which I used at the Edison Company, without in fact having the same leather that they used.

This device is one of the old acoustic recorders. In explaining recording, I mentioned that we had a trunnion. This we referred to as a trunnion. That was mounted in this position, which permitted it to float on the wax record as it was fed across by this speed screw. This is an old two-minute type.

MR. ASHTON: I ask that the recording element referred to by the witness be marked in evidence as Defendants' Exhibit 34.

(Received in evidence and marked Defendants' Exhibit 34.)

This is a sketch which I made up to more or less illustrate the method of applying a recording arm on these machines, the way we used them in recording commercial cylinder records. This is a top view of the same thing, showing its relation to the mandrel and the back rod and so forth.

Mr. Ashton: Note that the witness has referred to two sketches. I offer the sketches as Defendants' Exhibits 35-A and 35-B.

(Received in evidence and marked Defendants' Exhibits 35-A and 35-B.)

The machine, Defendants' Exhibit for Identification 31, has a flywheel on it. This is it.

Q. 61. Did the machines which you have referred to as having been used for making the regular production of commercial phonograph records at the Edison plant have flywheel on them?

A. All of them.

As to whether they were like the flywheels on this machine, I believe they were all made from the one pattern. They all look enough alike to be made from the one pattern. The purpose of the flywheel on the cylinder machines is more or less for stabilizing the rotation of the cylinder and damping out any pulsations or fluctuations or flutter that might come up from the driving motor under the top plate. The flywheel was driven by a belt from the motor for that same purpose. To keep any of the motor fluctuations from being transmitted to this record carrying mandrel. The purpose of the governor on the motor is to establish its speed. The governor has to do with the control of the speed. That is one of its main functions. As to what I meant by "establish the speed,"

as the springs through the intermediate gear press power on to what we call the belt drive intermediate gear, the teeth on that engage the pinion gear to which the governor is attached. In this case a three-ball governor. As that intermediate shaft tries to rotate, naturally, it turns the shaft containing the governor control. As it revolves, the balls tend to flex the spring outwardly until the governor control disc makes contact with a felt pad on the governor control arm or tuning arm, as we call it.

CROSS-EXAMINATION.

By MR. WARD:

The contact made on the tuning arm by the governor balls flying out establishes the rate of speed at which this pulley turns, which is attached to the same shaft as the intermediate gear. The flying in or flying out or receding of the ball governors does not operate on this pulley, and through the pulley. The flying in or out of the governor balls would denote either one of two things. Either unbalanced governor balls where they have been fractured or injured in some way. Assuming the governor balls are all right and in perfect normal operation, the function of these governor balls is to determine the speed of the shaft and also regulate the speed. The governor balls determine and regulate the speed of the shaft to which the belt driving the upper mandrel shaft is connected. And that belt passes over a pulley which is rigidly connected to this flywheel. The governor balls establish the speed of the flywheel. The flywheel is on the same shaft as the mandrel of the sound record. It is rigidly connected. One of the functions of the governor balls is to control and establish the speed of the mandrel. There are two threads on this machine. Those threads are for feeding the arm carrying either the recorder or the repro-

ducer across the record. Feeding this carriage across the record, which carries either the reproducer or the recorder.

XQ. 80. And how is that arm moved back and forth with respect to the mandrel? Did you have a split nut that engaged either of these threads?

A. It is on there now. It is a half nut. You call it a split nut.

There is half a nut on the carriage now beneath the lower plate. That particular nut is not switched either to the rear thread or the front thread, according to which one you operate on. There was a particular nut which is out here, on a smaller arm. Not two nuts at one time. Either one or the other can be put in operation. The shaft carrying the rear thread is connected by a sprocket chain to the mandrel shaft, which carries the front thread. The sprocket chain that is in the machine is probably the original chain, but it is well worn now. That chain was on there when I got the machine from Mr. Getcliffe's home. As I stated before, the spring motor was a motor that I had brought home from the Edison Laboratories around 1916 or 1917. I cannot say definitely whether this machine was ever used outside of the Edison factory. Others like it were all over the United States and Europe. Like this one. I have seen plenty of other machines exactly like this. They were in use when I first went to work for the Edison Industries in 1908.

I know of my personal knowledge when Mr. Getcliffe got this machine. As I said before, it was either 1916 or 1917. I saw him get it then. I got this machine early this year. February of this year. When I was asked to get it, it was not particularly for the purpose of this suit here. I am making doll records, whereby I am using some of our old equipment, part of some of our old equipment, and I had to use it, I

had use for it, in that work. Records for talking dolls. They are small cylinder records that run a half a minute, that they put inside of talking dolls. I have not used this machine to make those records. What I meant by saying that I got this not particularly for the purpose of this suit was so that I would not have to tear down or revamp any of my own equipment to furnish this machine. I got this for the purpose of this suit. As to what I meant by saying that with a suitable lightweight reproducer, you would start the machine in motion, was that in recording, any recording is done on a wax composition. We will call it on the order of Ivory soap. And in order to reproduce from that wax you have to decrease the effective weight on the needle point to a great degree to keep from tearing the wax, so you can hear your reproduction. If you put a wax cylinder on this mandrel here, you have to decrease the effective weight of this floating mass, which of course actuates a leverage for your vibrations. When you want to reproduce a commercial record you use a reproducer of this type or some more improved type. I have reproduced a little on this machine. The same machine here, within the past few months. As to where I got the records from, around different friends that I knew had some. I only had one or two. Two, I believe I had. I have not any here. I tried those records out several weeks ago. I have not tried any of those in the last week. I have other records. I did not have to tell anybody how they worked out, how they sounded. I had other people that were listening to them with me. I demonstrated them to some of the counsel in this suit.

I made up the sketches, Exhibits 35-A and B, about a week and a half ago. They were made up from looking at this machine. I tried to explain to Mr. Ashton the difference between the reproducing arm and a recording arm, and he said to kindly sketch it for him so that he could understand. These sketches are in-

tended to show the manner in which a recording mechanism is put on this machine. The element on that arm now is a reproducer. This sketch is made from my recollection of the recorder plus this old part, which we used at that time. That old part is Exhibit 35. I did not have anything to do with the building of these machines like this model, only keeping them in condition. Keeping them in condition after they were in service was more or less of a side duty. I worked on them if they needed a belt adjustment or any other adjustment. My duties in the recording laboratory were recording sound. They had mechanics. Repairing was not any part of my function for the outside machines. We all took care of our machines and took a certain pride in keeping them in A1 condition. The play in this Defendants' Exhibit 35 around that pin just happens to be in there. When that is properly set you feel no play in there. In fact, the effort is to get no loss of sound through any leakage there. Back in 1908 or 1910 these joints probably were perfectly uniform and without any play. I operated many of them. I will not commit myself on that particular one, no. The ones we operated were as good a fit as we could get without any drag. The function was to ride freely on that cylinder, and if you had a bind in your centers there, it would show up very quickly.

XQ. 141. It appears to be, Mr. Webber, that this flywheel here is a rather crude-looking thing. Why did they put a flywheel like that on this machine, if all of their flywheels were made from the same pattern, as you thought they were?

A. What do you mean, why did they put a flywheel on that machine?

XQ. 142. This looks like a rather crude affair to me. Is that a production job, that flywheel?

A. It is according to how you look at the production. From time to time, if these threads on this mandrel shaft happened to be injured, it was necessary to replace them with a new one, therefore we would take off this flywheel and pulley and replace them on a new shaft, the mandrel shaft with a thread, adjust them for balance or rebalance and, if they did not balance up, just right, they might bore holes in them or add a little solder to them. As long as they got them in balance that is all they cared for.

XQ. 143. You used the flywheel as a means of balancing your mandrel and screw shaft?

A. That was one of its reasons.

It was and it was not a rather important thing to have done to keep that mandrel and screw shaft in balance. Without that flywheel on there, you still have plenty of flywheel effect from this present mandrel. This flywheel has pieces gouged out of it or put onto it, to have the whole unit in balance. That it is important to have this mandrel and threaded shaft balanced has been known from the day anything was turned, where constancy of speed entered into it. Balance and constancy of speed is a product of the same thing here. I am confining myself to phonographs. It is not a function, and an important function, of this flywheel, to balance this mandrel and shaft on which it is.

XQ. 151. Then why do you have these chunks cut off and put on here from time to time?

A. This particular one is to permit the removal of this back rod without disassembling the shaft. As I stated before, when they were once put on, and it was balanced as a unit, they were not supposed to be disturbed. Any occasion that called for disturbing them, called for rebalancing, if necessary, and therefore this was put in there to permit you to slide the back rod out.

XQ. 152. These lugs or cuts have nothing to do

with sliding in or out. I asked you why are these things like this nub were put on, or this piece cut out, if you are not after balance.

A. This is part of the pattern to offset what has been taken out here.

I see this surface here. That was probably not in that condition when that casting was first built. And this was not either.

XQ. 155. Didn't you tell me that from time to time it was important to balance this mandrel, and that the flywheel was used for that purpose?

A. Partially. All commercial machines have a balanced mandrel on them, more or less.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

RDQ. 156. You referred to keeping the recorder light so that it would not exert much pressure on the record. Were you referring to the original wax recording records which you wanted to reproduce?

A. I was. As to why I took such care with those records in the first place, that was the only way you could get a good reproduction from them, by using something extremely light, something light enough not to distort the sound wave on there. Those records were to be used primarily for playback purposes, when we reproduced them with the lightweight reproducer.

RDQ. 159. Were they to be used later to make commercial records?

A. We seldom had processed any records that we had played, but many of the cylinders, of course, were.

Each man was responsible for his particular machine. If he was not capable of handling them himself, there was a mechanic there for that purpose. Each man was responsible for his own machine.

RE-CROSS-EXAMINATION.

By MR. WARD:

The model mark of this model was the Triumph. I imagine about 1904 or earlier. I will swear to 1908 or earlier.

RXQ. 165. And it is your testimony that the other machines of this model had the flywheel secured to them just as this one is secured on this machine?

A. They did. On all that we ever used.

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HARRY F. GETCLIFFE, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live in Orange, New Jersey. I am thirty. My father's name was Harry Getcliffe. He is deceased. He died August, 1931. My father was employed by Edison, Thomas A. Edison. That company was located at 79 Fifth Avenue, New York. He was employed by that company twenty-nine years. He stopped working for the Edison Company about 1929. He was historical librarian for the Edison Company and he also made master records for singers that came in to have their voices tested.

My father brought this machine, Defendants' Exhibit 31, home, I guess, some fifteen or sixteen years ago from 79 Fifth Avenue, Edison's Industries. Thomas A. Edison. We have had the machine at our house ever since that time. I turned it over to Mr. Webber recently. Some time in February this year. As to what my father used this machine for, well, it was sort of a recreation for the family, and he made a few little records for us of the children's voices.

We had three sisters and myself. That is, he recorded on the machine. He reproduced on the machine, he played the records. As to whether I remember any incident in connection with his recording of my sister's voice, I recall it is some time ago, because my sister today is seventeen and, in order to get her to say something—she could not talk at the time—he had to pinch her to make her cry or do something, just to get her voice on the record.

MR. ASHTON: I offer in evidence the machine previously marked for identification as Defendants' Exhibit 31.

(Received in evidence and so marked.)

CROSS-EXAMINATION.

By MR. WARD:

I say that my father brought this machine, Exhibit 31, home about fifteen or sixteen years ago.

That would be about 1917 or 1918. I have seen this machine quite a lot; it kicked around the house for quite a long while. My father had to pinch my sister to make her cry to record her crying. We all said something in the record, and to get her in he pinched her, to get her voice in. That is the incident I refer to as using the machine to amuse the family at our house.

I am a plumbing and heating contractor. I am in a mechanical line of work. I understand pumps and things like that. I don't know about castings. I don't know anything about castings.

XQ. 31. Will you come down and look at this model with me? Do you observe in this Defendants' Exhibit 31 that the bracket which extends from the front of this machine around the ends and over to the other side has been cut with a jigsaw or something like that to make it fit in with the bracket, which carries the outer screw shaft above it?

A. I see it the same as you do there. I see that this bracket shows a cut running beyond the upright part that has been cut out.

XQ. 33. And you observe that the rest of this machine has been painted black and decorated, don't you? Look at it. Look at the edges of it. It has been painted and decorated, hasn't it?

A. I would not say lately.

XQ. 34. I do not say lately, but it has been.

A. When it was made is when that was done.

XQ. 35. And all of this casting work has been painted black and decorated. Now, come around and take a look at this bracket here. That is just a rough casting, isn't it?

A. It seems to be.

XQ. 36. Doesn't seem to have the finish that the rest of the machine has, does it?

A. Maybe it is a different metal. I don't know.

XQ. 37. The top of this machine—look down here so that you can see it—on the plate that bears the name Thomas A. Edison, has five holes drilled through it, hasn't it?

A. Yes, sir. There is nothing that is fitting in those holes now. This brass sleeve which is carrying the stylus carriage has two screws, set screws, or finger screws, which are intended to set that sleeve on the member on which it is supported.

XQ. 40. And will you examine that screw with the finger piece on it and tell me if that brass piece has not been simply soldered on the head of that screw.

A. There is solder there.

XQ. 41. You would not call that a production job, would you?

A. I don't know; I could not tell you.

XQ. 42. Now, will you look at the sprocket wheel on the outer thread shaft and tell me approximately

how much out of line it is with the sprocket on the mandrel shaft which the sprocket chain runs over.

A. I could not tell you anything about that.

XQ. 43. Yes, you can. Look at it. Take this piece of paper and hold it in line with your hands and tell me how much out of line it approximately is. Roughly a quarter of an inch or something like that?

A. I cannot tell you that. I have to line up things in my work. We use a straight edge and plumbs and things like that.

XQ. 45. Take a straight edge and tell me how much you think those two sprocket wheels are out of alignment.

A. About an eighth of an inch, I should say. An amount about equal to the width of the sprocket or hole.

XQ. 47. Now look at this part of the carriage that I have called your attention to, the carriage for the outer bearing of the mandrel shaft. Come around here and look at it here. I am referring you to the casting that extends from what is the rear of the machine around and carries the outer bearing for the mandrel shaft and comes around to the front of the machine and is secured to the plate on which the name "Thomas A. Edison" appears. That is the part I am referring you to. Now, do you see two pins here sticking out from that casting?

A. Yes, sir. I do not know what they are for. I don't know whether it is a production job or an experimental. I do not know when that lead was cut off from the left-hand side of the flywheel

I wouldn't say it has recently been cut off. I don't know.

XQ. 52. It is shining. Don't you cut lead pieces right along in your plumbing work?

A. Sure.

XQ. 53. Well, don't you know when a surface looks like it has been recently cut, a lead surface?

A. It don't look recently cut to me.

XQ. 54. Well, does it look anything like as old as the flywheel? Look at it. It is bright, isn't it, shiny? It is relatively shiny, isn't it?

A. It is the metal.

XQ. 55. Well, for lead. You deal in lead right along, you cut lead as a plumber, don't you?

A. Yes, sir. It is not as shiny as new lead.

XQ. 56. About how long does lead retain its sheen after you cut it and expose it to the atmosphere?

A. I couldn't tell you.

I have never had this flywheel off of this pulley. I never touched that. As to whether I can state that this machine is now in exactly the same condition as it was when my father brought it home, well, I can only say that the changes Mr. Webber made on it is the only difference. I don't know all the changes Mr. Webber made. I do not know what Mr. Webber has done with it since he got it from me. He got it from me last February. I do not know what this reduced part of this shaft between the thread and the mandrel is for, where it is reduced here. I do not know anything about how that sprocket is connected on to that shaft on which the chain runs.

XQ. 65. In other words, all you know about this machine, Mr. Getcliffe, is that about 1917 or 1918 your father brought a machine home that is substantially like this, as far as you know, but you do not know what changes may have been made in it?

A. He brought this machine home; that is what I know.

Subject to such changes as may have been made in it since it left me, a few things I suppose they did to put it in working order; that is all. A few things that Mr. Webber made to put it in working condition.

I also see these dowel pins over here on the back side of the machine. That same casting that we have

been talking about that carries the outer bearing of the shaft. Just under the rough hacksaw cuts. And the upright bracket that is secured to the plate marked Thomas A. Edison and carries the bearing for the second threaded shaft at the rear of the machine; that also has dowel pins going through it.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

Defendants' Exhibit No. 33 for Identification was on the machine when I delivered it to Mr. Webber. That is the band, I guess, or whatever it is.

Defendants' Exhibit No. 32 for Identification was on the machine when I delivered it to Mr. Webber; that is the insides.

RDQ. 73. The motor that is now in the machine was not on it; is that correct?

A. I didn't see it. I don't—(witness lifts top plate of machine box). Yes, that is right. There is the motor that was in it.

MR. ASHTON: I offer in evidence the spring motor previously marked for identification as Defendants' Exhibit 32.

(Received in evidence and so marked.)

MR. ASHTON: I offer in evidence the belt previously marked for identification as Defendants' Exhibit 33.

(Received in evidence and so marked.)

WILLIAM C. DURYEA, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live at Princeton. I have lived there about twenty-eight years. I am employed as a technician in the Palmer Physical Laboratory, Princeton University. I have worked in the Palmer Laboratory about twenty-eight years, with the exception of two years which occurred during the war period. In that time I was employed by the Government. I was employed by the Government to develop and help make sound apparatus used by the allies for the detection by the allies of the enemy's artillery. After the war I returned to my position. I went back again on routine work at the Palmer Laboratory.

I built an oscillograph. This machine is an oscillograph I constructed early in the year of 1919. I constructed it for Professor Trowbridge, who was then professor of physics in the university. Some time after he was appointed to represent the Carnegie or the Rockefeller Foundation in Europe. Later on he returned to the university and was appointed dean of the Graduate College. Professor Trowbridge had to resign about a year ago on account of ill health. I designed the machine. Professor Trowbridge offered a suggestion shortly after he came back from his work in France, where he had charge of the sound range apparatus; he suggested it would be a fine thing if we could make a high speed photographic recorder, one capable of photographing at a high rate of speed and being able to develop at a rate sufficient for proper development of the film. And that is the result.

I made the machine in about April or May of the year 1919. It was completed in about six weeks; five or six weeks after we started construction work.

This is a magazine containing a roll of photographic paper and it is placed in that position on the top of it. The paper is fed down past a cylindrical lens housing by means of two rollers. The cylindrical lens housing is provided with a rectangular slit or opening which admits light from the cylindrical lens to the film as it passes that point. The rear face of this housing is provided with a velvet covering. The object of the covering was to protect the emulsion side of the film from abrasion and also to provide a light-tight joint. The film passes down between an idling roller and a driving roller, and to this driving roller is rigidly attached this flywheel. The object of the flywheel was to maintain approximately uniform motion of the camera and also uniform velocity of the film while passing the opening in the cylindrical lens housing. The film passes from that point downward through a cutting-off device, and from there, between these two developer rollers, down into the developer tank, it emerges from the developer tank and goes into the fixer tank. After emerging from there the film is ready to be rinsed and observed or to be dried if it is intended to be kept as a permanent record. Roughly that is the construction.

This is the shutter or opening and it is provided with a bilateral slit, meaning two jaws which recede or close at a uniform rate. The purpose of adjusting those jaws is to admit the proper amount of light. You adjust them by this thumb screw. There are some parts on the machine which are not the original parts. The film holder is not original. This aluminum casting is not. It is a substitute. The adjustable jaws are the same jaws that was in the original housing. The original string holder was a single unit containing two strings. Later on that was discarded and those two which are separate string holders put on. The object of that was that a string, if it became damaged

or broken, might be replaced without taking out both strings and putting the machine out of commission. Not a bit of difference in the function between the old strings and the ones now in the machine. One part has been removed from the machine which was on it originally.

The machine was originally designed with a roller there, and the function of that roller was to turn the film down after emerging from the developer tank, to allow it to go, or rather, to guide it in the fixer tank; but after the machine was put in operation we discovered that that was unnecessary and we eliminated the roller. I have been referring to the camera part in this particular case. The little member that I am pointing to now is a boss put there for a bearing. The parts I have referred to were replaced probably a year or a year and a half afterwards, and that came about in this way: we had furnished the Hupp Motor Car Corporation of Detroit with detailed drawings to enable them to make a machine, and they made patterns, and when the completed machine was shipped in to Princeton to be tuned up the patterns came with it. The Hupp Company duplicated that machine. The Hupp Company was developing a new eight-cylinder crankshaft motor, and they were having a great deal of trouble with torsional vibration of the shaft at certain objectionable speeds, so they used this machine in eliminating that trouble. We used the machine in Princeton to take many records of the explosion pressures in gasoline engines. We used it with various different experiments. I remember we took graphs of musical notes. We made graphs of the human voice, using a telephone transmitter in connection with an amplifying device. The machine was used almost continuously before March 24th, 1921.

Mr. Ashton: I offer the machine in evidence as Defendants' Exhibit 36.

MR. WARD: I make a formal objection on the record, your Honor. I object to it as immaterial and irrelevant, as being an entirely non-analogous art. I suppose you will overrule that.

THE COURT: Yes; I will overrule that objection for the present.

(Received in evidence and marked Defendants' Exhibit 36.)

This piece of paper is a graph that was taken of that machine. It is an oscillograph record. We made many records on this machine of the type of the record shown on this piece of paper.

MR. ASHTON: I offer in evidence a strip of paper referred to by the witness and ask that it be marked Defendants' Exhibit 37.

(Received in evidence and marked Defendants' Exhibit 37.)

As to what is the width of the line of light produced on the film with this cylindrical lens that is in the machine, it can be focussed down to about one sixty-fourth of an inch. That will depend entirely on the character of the lens. It can be made much narrower by a better lens, or a lens ground more accurately. In ordinary work, the ordinary commercial lens is quite good enough. The black line on this strip of paper is about the size of the exposure from the cylindrical lens.

MR. ASHTON: I offer the strip of paper in evidence as Defendants' Exhibit 38.

(Received in evidence and marked Defendants' Exhibit 38.)

The two little breaks on the line are the shadows of the two strings. There was a patent application filed for this machine by Emery, Varney, Blair &

Hoguet. They are patent attorneys. I did have something to do with this patent application. We shipped the machine over to New York and later on followed it over and unpacked it and assembled it and instructed a Mr. Dix, who had charge of the work, in making out the patent drawings and specifications, and so forth. It was shipped to the patent attorneys the latter part of June, 1920.

The machine is shown in the drawings of this Duryea and Trowbridge Patent No. 1,477,913. As to whether there are any differences between the drawings of the patent and the machine Exhibit 36, the cylindrical lens housing is of a slightly different design, and the string holder is different. There are no differences in function between those devices. That is, none between those devices and the corresponding ones on the machine. And there is also a difference in the drawings relative to this developer roller mechanism. This was changed in the mechanism, and the change was only suggested to make it a simpler manufacturing problem. Although this was the original one. And I discovered, in making this, that that was rather difficult. I am referring to Figures 10 and 11 of the patent. There are two arms shown in Figure 10, namely, 76 and 77. Those are the arms I am referring to. There is a single arm on the machine. The patent attorney who did the work on the application was Mr. Howard Dix.

That is a book or file of a few of the records that Mr. Trowbridge and I collected during our experiments. The page bearing at the top the following: "June 21, 1920. Last test of indicator and recorder before being sent to patent lawyers." was made up prior to June 21st. It may have been a day or it may have been a week prior. There is no date on this particular sheet. The three records on this sheet are graphs of explosions, compressions, exhaust and induc-

tion of a gasoline engine. I do not know what has happened to the other records which apparently were on this sheet. They were destroyed or lost. They were not considered of any value. The book was not considered of any value. When Mr. Trowbridge gave up his position at Princeton and sailed for Europe, he brought that book, which contained the patent papers and some other papers that were of value, and said for me to take care of it. I placed those in a drawer in a cabinet, a filing cabinet, and forgot about it until very recently.

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ARTHUR G. DANNELL, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live at 3323 One Hundred and Sixty-seventh Street, Flushing, Long Island. I am a patent draftsman. I was formerly employed with Emery, Varney, Blair & Hoguet, 149 Broadway, New York City. They are patent lawyers. I was employed by them during the year 1920.

MR. ASHTON: It is stipulated and agreed that Mr. Dannell, if further examined, would testify that he made the drawings of Trowbridge's Patent 1,449,913 from the machine, Exhibit 36, as it was in 1920; that he would further testify that the differences in the machine as it now exists and its condition when he made the drawings are the same as Mr. Duryea, the previous witness, has testified; that the drawings were made in July or August, 1920.

MR. WARD: All right.

CHARLES A. WINKLER, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live at Camden, New Jersey. I am a cost accountant for R. C. A. Victor Company. I have been employed by the Victor Company since March, 1914. I was employed in the treasurer's office of the Victor Company from 1914 to 1928. I was supervisor of costs and the placing of orders on the factory for the manufacture of instruments. The machine across the room is a talking machine manufactured by the Victor Company. It is model 11 Victrola. This machine was made from the latter part of 1913, until the latter part of 1913. Machines of this type made were made from 1910 to 1921 inclusive.

This book is the permanent record kept by the Victor Talking Machine Company of instruments shipped during that period. It appears from this book that the following quantities of model 11 Victrola were sold: in 1910, 1499; in 1911, 4793; 1912, 15,141; 1913, 44,083; 1914, 51,051; 1915, 81,489; 1916, 112,714; 1917, 115,828; 1918, 70,214; 1919, 124,117; 1920, 192,273; 1921, 40,697; making a total of 853,899.

MR. ASHTON: I offer the machine in evidence as defendants' exhibit.

MR. WARD: Just one question.

CROSS-EXAMINATION.

By MR. WARD:

XQ. 15. You say that this type of machine was sold from 1913 to June, 1920, or thereabouts; are those machines exactly the construction of that machine, except the cabinet?

A. No, the cabinet changed in those years.

The mechanism was practically the same, yes. I would say practically I do not know anything about the mechanism. All I know is that machines of this Type 11 were sold. I am not familiar with the mechanism in the machine.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I made up the cost from which this Type 11 machine was sold. That meant making up the cost for each particular part of the machine. We were furnished by the engineering department with group drawings which enumerated the parts that were required for an instrament of that description, and from those drawings we made up costs by operations, the time being reported by the factory, the materials specified by the engineering department; other than that we had no reason to know what the functions of each different part were. Every one of the Type 11 machines had turntables on them. All of the Type 11 machines had ball governors on them. They all had spring motors.

(Type 11 Victrola received in evidence and marked Defendants' Exhibit 39.)

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W. E. STORY, JR., called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live in Worcester, Massachusetts. I worked for the General Electric Company from 1911, in January, to 1922. I have an A. B. from Harvard and a Ph. D.

from Clarke University. After I received my doctor's degree from Clarke and before I went to the General Electric Company I was Dr. Webster's laboratory assistant for a year. Then I went to Europe. Then I spent a year on further work on my thesis.

I went to the laboratory at Schenectady in January, 1911. The subject of my thesis was the Poulsen arc. It was the research laboratory that I entered.

To summarize briefly the work which I did up to 1915: When I first went there I worked on the Doremus process for the production of alumina. After that I worked on the development of the mercury arc rectifier. That continued through the spring of 1915.

I do not know about when the General Electric Company acquired its first alkali metal photoelectric cell. I only know that we had one in the laboratory in 1915. As I understood, it was acquired from Professor Kunz of the University of Illinois. I personally used this Kunz cell. The idea had been suggested to use the Kunz cell in connection with a so-called negative resistance, which Dr. Hull had developed in the laboratory for the production of motion pictures; that is, for the writing of a sound record on a motion picture film and for the production and reproduction of that into sound.

This is my laboratory notebook No. 3 covering the period extending from July 14th, 1915, to April 2d, 1918.

Q. 16. Do you find any entry in this book with respect to the use of photoelectric cells for talking movies?

A. I do.

On page 23, under date of the 23d of October, 1915, I find this entry:

> "Quite a long talk with Hull about talking movies. Langmuir suggested in that talk yester-

day using a two-tenths of a mil filament in hydrogen, that would heat and cool down rapidly enough to follow 4,000 vibrations. This, if focused on a slot across the edge of a film, would give a strip of varying intensity when developed, and this strip, run past a similar apparatus, would let through light of varying intensity upon the photoelectric cell. Both the recording apparatus and the transmitting would be placed probably below the lowest ratchet wheel where the motion of the film is uniform."

Langmuir was the Irving Langmuir, the well-known physical chemist. Dr. A. W. Hull was a member of the research laboratory staff. The suggestion of Langmuir involved the use of a modulated source of light. By 4000 vibrations was meant 4000 complete cycles a second. By the lowest ratchet wheel I meant the lower sprocket, the sprocket wheel below the film gate beyond which the film had a constant motion. By "a slot across the edge of the film" I meant a narrow hole in a plate adjacent to the film on which the light fell and through which it went to mark the film. This ratchet wheel was the ordinary lower ratchet wheel of a motion picture projector. The sound unit was to be below that. That is, the photoelectric cell was to be below that.

Q. 25. You stated that the wheel was a "ratchet wheel." Would or would not the term "sprocket" be synonymous?

A. Yes, it was.

Q. 26. Did you mean a sprocket wheel?

A. Yes. I meant what is now called a sprocket wheel. At the time I was not very familiar with the nomenclature of the motion picture profession.

As to the next reference in my notebook to this motion picture work, on page 25, under date of the 27th

of October, I find a diagram of the standard motion picture film. This I drew up in order to determine what space was available on the film for the recording of the sound record, so as not to interfere with the picture record.

Concerning the next entry in my notebook on this subject, on pages 56 and 57, under date of the 21st of December, 1915, I find a discussion of various ways of producing a varying exposure to the film for small variations in current. I decided finally that a mirror hung in an oscillograph was probably a better source with which to begin this work than the small filament running in hydrogen. I preferred that method.

Q. 30. Would that method produce a variable area sound record?

A. Yes, it would. The filament would produce a record of the same area, but of varying intensity.

The next entry in my notebook—on page 58, under date of December 27th of the same year; from this entry, we were setting up an oscillograph, preparing to obtain from it the graph of a sung note. We proposed to put the film on which this graph was photographed inside of a large glass tube down the axis of which a converging beam of light was intercepted by a small mirror put at 45 degrees with the axis; this mirror directing the light on a narrow slit, just before the light came to the film. Accordingly, the light went through the slit, then through the film, through the glass cylinder, and into the photoelectric cell on the outside. This was a reproducer. The photoelectric cell I was going to use with this reproducer was the cell that we had in the laboratory at the time, the Kunz cell, to which I previously referred. There is a reference to the use of the photoelectric cell in this note. "This light after penetrating the film and glass, falls on the photoelectric cell, and here breaking up

ions which give us the current. This is magnified with the dynatron to the desired point." As to whether I planned to use an amplifier, I planned to use this dynatron of Dr. Hull's. I just read the entry referring to the amplifier. The dynatron was one of the three-element vacuum tubes. There is quite a large family of them. It was similar to the pliotron, except that—well, the fundamental difference was that the grid had a large positive potential with respect to the filament instead of a slight negative which it has in the pliotron.

My next entry is on page 61, under date of January 6th, 1916. It reads: "We have taken a number of oscillograms, as shown on page 57 at the top, and are now arranging the photoelectric cell for reproduction of the electric currents. The dynatron is not nearly as sensitive as it should be. Hull suggests a storage battery for the filament as necessary." I am referring to page 57 of my notebook in that note. We did not set up the arrangements which I have described. Asked what he did between January 6th and January 31st, 1916, the witness said: Well, at the same time, before we stopped the rectifier work, I had been put in charge of the equipping of a building down the line for the making of magnesium, which then was needed for war work; and during this period which I have been covering just now, the work was more or less routine, could be followed without much time or thought, but from this on, a number of questions developed on which the whole manufacture depended, and most of my time had to be put into that.

I have here an entry on January 31st, 1916, page 73 of the book; among other things: "Set up pliotron with the plate fastened to the positive 250 volts, through the photoelectric cell. No amplification. Then White came down and arranged it as shown, with a better pliotron. This gave great amplification."

As to the records used on my reproducing machine in obtaining this amplification, we used first a photographic film with lines drawn on it in india ink. Then afterwards we used the photographic reproduction of a whistle. The whistle was recorded by an oscillograph. I am not sure whether the one indicated on page 57 of my notebook was the same oscillograph exactly, but it was of a similar type. It was a standard oscillograph. The general arrangement of the oscillograph for recording the whistle was that we had a telephone transmitter in series with three elements, the three needles of an oscillograph set in series. The images of the arc in the oscillograph were drawn close together, side by side, so as to give a very broad band of light on the oscillograph film; and as this was shaken, we could cut off one-half of it by a screen and still get a perfectly complete curve varying the light into the cell. The sensitive material used in the oscillograph for the record was an ordinary oscillograph film, cellulose film. It was transparent film. The film was located in the oscillograph immediately behind the cylindrical lens. It was on a drum. It was held on a drum about four inches in diameter, perhaps a little less than that, which was rotated behind the slot. The film was about a foot long.

Referring to page 74 of my notebook I read the entry under February 2, 1916: "Yesterday with the above arrangement gave such good results that we tried it first on the black lines inked on the film and then on the photograph of a whistle. Even in the last a response was distinctly audible in the telephone." Describing briefly the electrical arrangement referred to in this note on page 74, the photoelectric cell was arranged in series with 250 volts positive and one coil of a transformer, the other end of that coil being grounded. I am referring to the sketch in my note-

book showing this circuit on page 74. The other coil of that transformer was arranged in series with the grid of the pliotron and a small negative bias potential. In the plate circuit of the pliotron was one coil of a transformer, the other coil being directly across the terminals of a telephone receiver. The photoelectric cell is down here in the lower left-hand corner. The telephone is over to the extreme right. The vacuum tube is in the center.

From February 2d, 1916, on almost all my time was put on problems in connection with this magnesium production. A good many things had come up there that really had to be solved. We set up a plant for the production of magnesium. We were able to do very little further work on sound recording and reproduction during this period. I had one man working on the cell itself, but I could give very little time to it.

The witness was asked to state briefly the nature of his work on submarine detecting and stated: Now to state the nature of the submarine signal work. In the first place, in connection with this dynatron, this negative resistance that Dr. Hull had initiated, there seemed to be ways from that of getting very powerful oscillatory waves, oscillatory discharges that could be used in connection with reflection, in which you could produce the sound yourself and, by hearing it reflected from such a thing as the hull of a ship, say, or a submarine, you could detect the presence of those submarines without their making any noise at all. I can't say that there were many people working on this particular problem in addition to myself. That was the thing towards which we were working; but first we had to do a good deal of work on the characteristics of the negative itself. As far as I know, only Dr. Hull and I were working on that. A good deal of the rest of the laboratory was working on

war work. I am not sure when it began, but certainly after we got in the war, most of it was work on war work.

Q. 71. That is after April, 1917?

MR. WARD: It will save a lot of cross-examination if Mr. Ashton will only be a little more specific as to whether they were working on PE cell on Hull's circuit, or what?

MR. ASHTON: No. War work.

MR. WARD: War work.

It appears from my notebooks what period the war work covered. Pages 1 to 62 deal entirely with submarine detection, war work. This brings us down to October, 1918.

As to my next work in connection with motion pictures, well, in January there was a time there after that when a few things had to be picked up after the War, but on January 13th, 1919, Mr. Orange, who had been working for the laboratory on projection work, decided to go to England permanently, and his work was turned over to me. That was, I suppose, because I was already interested in motion pictures through this sound work. The General Electric Company had just brought out a 900-watt motion picture lamp, and they were interested in finding the best possible optical setup for that lamp, so they could tell just what arc installations they could supplant with the new incandescent lamp. I used a photoelectric cell in connection with those investigations. We very soon found that the ordinary methods of optical photometry were very unsatisfactory for this work, not only inaccurate, but clumsy. We accordingly set up a photoelectric cell in connection with a sensitive galvanometer for automatic recording of varying sources of light. That recording was by reflection from a galvanometer on a photographic plate.

I am not quite sure of when the General Electric Company first made a potassium photoelectric cell, but I find here a note on page 226 of this book No. 224, under date of the 15th of March, 1920, the following: "Our old cell had no dark current, but the last few have had—except the very last one. This and the first were made with silvering solution instead of volatilized silver."

Volatilized silvering was a method we developed in the laboratory for the production of the silver coating. The cells referred to here are cells we made ourselves in the laboratory. Just as soon as we made them. I used cells made by the General Electric Company. I cannot say about when that was. That would be contained in the notes of some of the other men in the group, Mr. Ottman, Mr. McGraw, Mr. Ruggles perhaps.

I referred to silver in connection with these G. E. cells, and I believe did not mention potassium specifically. If you deposit potassium alone on the inside of the bulb, it is very apt to go on in discrete globules, drops, and of course they being completely surrounded by glass, you have no means of drawing off any current from them. What we used to do then was—this was quite a common practice, by the way—to coat the glass originally with a deposit of silver and then deposit the potassium on this silver, that silver acting as a conductor, so that all of the drops would be useful.

Mr. Hoxie was a member of the staff of the standardizing laboratory at the General Electric Company. That was not a part of the research laboratory. I don't think it was part of the general engineering laboratory. I am not quite sure of the organization there. It was quite separate from research.

Q. 88. Did you ever consult with Mr. Hoxie as to any use of the photoelectric cell?

A. Yes, I have.

As to when I first consulted with him, as far as my notes show on page 270, notebook No. 4, under date of the 22d of December, 1920 I find this note: "Talked today with Blank of the standardizing laboratory on illumination of oscillographs." I imagine at the time that I did not recall Mr. Hoxie's name. I take that for granted then that that was one of the first talks that I had with him, although we may have had talks before that, but in a subsequent note on the 19th of January, 1921, I find this:

> "The cell might be put in a safe as a burglar alarm. Quite a talk with Mr. Hoxie on the optical arrangements for maximum illumination."

So that there certainly I had a talk with Mr. Hoxie, although I am quite positive that we had talks before that time—on the date which I have previously given. The use of the photoelectric cell for burglar alarms was a practical one in my opinion. In fact, a variation of that has been used a good deal, I believe. The standardizing laboratory was in another arm of the same building as the research laboratory.

The optical arrangement which I discussed with Mr. Hoxie, referred to in my note on page 278 of Book 4, under date of January 19th, 1921, was an arrangement having as its object the obtaining of the maximum light on an oscillograph film, with a minimum sized mirror. It consisted in focussing the light on the mirror of the oscillograph and then refocussing again with two crossed cylindrical lenses. The film was to be used for the production of motion pictures; sound talking pictures. He was recording sound on film.

I had something to do with the selection of a name for the sound on film recording machine in which the

photoelectric cell was used. I realized that this machine had great possibilities—the photoelectric cell. The whole system of the conversion of electrical energy into sound energy by this method. And not being much of a Greek scholar and not having a Greek lexicon at hand, I asked Mr. Hawkins if he knew the correct word for "shaking." Between us we got a lexicon and found that the word "pallo" meant "to shake." We used originally the intransitive form of that, and called it "Palla," and of course the words "photo" and "phone," which were quite usual derivatives, and we compounded this word "Pallaphotophone," and probably someone using it since used the first word of the infinitive and called it the "Pallophotophone." This beam of light as it comes from the oscillograph needle, of course, just trembles all the time in conformity with the current going through the needle. Of course, it is a shaking or quivering light.

I have found some entries in my notebook as to other uses of the photoelectric cell which I have not already mentioned. I am asked to name those which occurred prior to March 24th, 1921. I have made a list of the ones that seem the principal ones. Under the date of the 11th of February, 1920, we set this photoelectric cell up in connection with a relay in front of the standard lamp and calibrated so that when another lamp was put in place of the standard, if the lamp fell as much as four per cent. in its illumination, the relay would trip out and a little pilot light would light alongside of it. This was easily adapted to an arrangement by which all of the lights, all of the lamps in a factory, could be run through this arrangement and sorted, so that those lamps which usually go into the 115-volt bin would automatically be put there. The lights in the 118-volt bin would be put there, and so forth. It would be quite automatic and save all of this bother with the then present photometry work in incandescent lamp

manufacture. That was brought about by my work in connection with the motion picture people and the work to which it led.

Then another use to which we put it was in development of the exposure of the positive film from the negative in motion picture work. That was the 22d of October, 1920. We also proposed to use it on location to determine the proper exposure for the negative film.

We proposed it on the 16th of December, 1920, as an X-ray exposure meter. As an X-ray exposure meter it could be worked very satisfactorily for that in order to explore over the area which you desired to photograph. It would give you an exploration of very, very small parts of the plate, a thing which had not up to that time been successfully found.

Then we used it as a torque indicator on shafts. The problem had come up of the shafts of large ships being strained, and we proposed mounting this photoelectric cell in connection with a lamp and a mirror and putting it at different ends of the shafts, to give you not only the actual strain on the shaft, but the varying strain, which was the thing which mostly caused crystallization.

Then we developed a little instrument which we called the telactimeter. That was on the 7th of February, 1921. This was intended for determining the proper exposure for negative motion picture film of any particular part of the set, and especially to enable the photographer to obtain the same general exposure of his plates, whether he was in a studio or on location. He could manage it all right in his studio with experience; he could manage it on location with experience; but he could not go from one point to the other. I believe nobody developed that amount of experience.

(Pages from Story note books received in evidence and marked Defendants' Exhibit 40.)

CROSS-EXAMINATION.

By MR. WARD:

Mr. Ward has examined the proposed pages of my notebook with me during the lunch recess. Page 23 of the first, No. 3, notebook, the first one I referred to, under date of October 23d, 1915, makes a reference to a filament lamp. That is an incandescent filament lamp. We simply proposed to try the use of such a lamp for recording. Everything that appears on that page is merely a proposal, nothing had been tried up to this time. And on that page I refer to a slot across the edge of the film. That is what we call a physical slot, up against the film. I referred to a talk with Dr. Langmuir at about that time, where reference is made to 4000 vibrations per second, which I said was 4000 complete cycles per second, At the time it was considered that if we could find a source of illumination which would vary at that speed, it would give satisfactory projection of sound. Of course, the sound would not be perfect, because the human ear can go a good deal higher than 4000, but it at least would give you a well-recognized sound. And he proposed something that would take us up to 4000. He proposed to run a two-tenths mil filament in hydrogen. That is, he proposed the use of a filament lamp which he thought would take us up to 4000 cycles per second. I did not follow that up. At that time I had a Kunz cell in my possession.

Then at page 25 of my notebook, under date of October 27th, I referred to a sketch. That was merely a sketch of a standard piece of motion picture film, that is all. Nothing else is disclosed on that page.

Then I referred to pages 56 and 57 under date of December 21st, 1915, and stated that I found there a discussion of various ways of producing a varying exposure to the film for small variations in current. And further reference was made to the fine filament. That again was merely a proposal for recording sound.

XQ. 88. And then you referred to page 58 of your notebook under date December 27th, 1915, and you stated that "we were setting up an oscillograph, preparing to obtain from it the graph of a sung note."

A. Excuse me, I did not say that. I said we were trying to get an oscillogram.

XQ. 89. You did not say "we were setting up"?

A. No. We were setting up an oscillograph and were trying to get an oscillogram.

XQ. 90. Then you were trying under this date to get an oscillogram of a sung note?

A. Yes.

XQ. 91. Did you get it?

A. I am not quite sure as to whether—on this particular date we did not. This is only a proposal.

XQ. 93. It says later on "We proposed to put the filament," and so forth. Then that was a proposal to get a sung note?

A. Yes.

XQ. 94. But it was not done?

MR. NEAVE: It was not done at that time, I think he said.

I referred in connection with my notebook, at page 58, to the "light, after penetrating the film and glass, falls on the photoelectric cell," and so forth. And "This is magnified with the dynatron to the desired point." And that again, I think I told you during the lunch hour, was merely a suggestion. We had not at that time done anything.

And then I made reference to page 61 of my notebook under date of January 6th, 1916, and I said that "we have taken a number of oscillograms, as shown on page 57 at the top, and are now arranging the photoelectric cell for reproduction of the electric currents. The dynatron is not nearly as sensitive as it should be. Hull suggests a storage battery for the filament is

necessary." We had at this time recorded the oscillograms. We found, as I say, that the dynatron was not sufficiently sensitive. We did not get an audible response. I say here that I am "now arranging the photoelectric cell for reproduction." So at that time I had not yet arranged the photoelectric cell or done anything with it.

Asked if at that time he decided that the dynatron per se was not nearly sensitive enough, the witness said: We did not mean that the dynatron was not sensitive enough to give us the proper response. We merely meant that the dynatron, as we had it arranged, driving the filament off a source of variable potential, we could not get the dynatron sufficiently into condition without getting variations due to the variation in the filament current. The dynatron was not necessarily unstable also. The dynatron, if used in connection with a parallel resistance, is unstable, yes, but you can pick a resistance which will give perfect stability, just as much as the dynatron itself has. The dynatron at this period of our suggestions for experiments or experimentation was not unstable the way we had it. Using connections with a particular sized resistance it may be unstable, but not necessarily so.

On page 73 of my notebook, under date of January 31st, 1916, I refer to the fact that I set up a pliotron and I described that to some extent and said there was no amplification. I did not mean by that that I did not use any amplification of the current. I meant that with that particular hookup that we had, we got no amplification. Under that date we tried two hookups. With the first one we got no amplification. With the second one we had a large amplification. I believe I said then with the hookup that gave us the best amplification, that I tried reproduction in two methods: one was from India ink lines drawn on a piece of film, and the other was by taking a record of a whistle

which was made on the oscillograph. That last was under date of the 2nd of February, 1916. I tried those two kinds of records for reproduction purposes with a PE cell. I stated with regard to the oscillogram record of the whistle that when I attempted to reproduce it with the PE cell that it was distinctly audible. A human whistle was recorded by the oscillograph. Somebody whistled. And with the PE cell in hookup the whistle was audible. The India ink lines on the film gave all the way from a strumming at very low frequencies to, well, a note more or less pure at higher frequencies. We had simply a telephone receiver to listen to the whistle. That is, we had one telephone receiver to the ear. The film with the India ink lines on it was drawn past the translation point approximately one foot a second, as I remember. I can't be quite sure of that. The record of the whistle was made on a standard oscillograph. My remembrance is that that was running about one revolution a second. And as it was the same diameter as the glass drum in which we had this film, I imagine we ran that at about the same speed. It was certainly in that neighborhood.

The arrangement which we used to reproduce this oscillograph record from was that we took the whole film that we had made on the oscillogram and put that around circumferentially inside of a glass cylinder. That is about a foot. The glass tube we had was about the same size as the oscillograph drum; and it was wrapped up on there, so it about fitted it. There was no spiral to it. It was not a long strip; it was only about a foot. And we just had it in the form of a band inside of the glass cylinder. It did not travel with respect to the cylinder. It was held in there with two metal clips.

If I may drop back to pages 56 and 57 of my notebook, the items on those pages, under date of Decem-

ber 21st, 1915, merely related to suggested forms of the beam of light for recording which were not used, had nothing to do with the production of a photoelectric cell. I might say that the form suggested on page 57, the form of oscillograph reproduction suggested on page 57, was that actually used in recording the whistle.

And with regard to the items on page 58 of my notebook under date of December 27th, 1915, I said something about "this magnified by use of dynatron to a desired point." During the lunch hour I said that that should read that this was meant to magnify, because I had not actually tried it at that time. Asked what he meant by saying that this magnified to the desired point, the witness said: I meant when I wrote that page 58, I was simply developing, I was putting down our plan of work as I had it in mind at the time. They were all propositions. We proposed to make the graph of a sound in this way; we proposed to run it into a photoelectric cell and reproduce it in this way; we proposed to magnify it with the dynatron.

Counsel states there are no proposed circuits or anything for the use of the PE cell up to page 58 of that notebook.

I don't believe I show the photoelectric cell in connection with the dynatron. Up to that time we had been studying it. It was very essential that we should know the characteristics of this dynatron. It was at the time an entirely new instrument. It was essential we should know its characteristics before we went into any very great development of the photoelectric cell. And before this date of December 27th we had been studying those characteristics in connection with high outside resistances, rather than in connection with the photoelectric cell.

Referring to page 74 of my notebook, under date of January 31st, 1916, I gave circuits there for the use of the PE cell. I was using the Kunz cell then.

I discussed the dynatron, its action, at pages 84 and 85 of that note book. It does not state in substance that the dynatron was not good. I see nothing there to the slightest detriment of the dynatron.

I did not find anything in my notebooks with respect to the PE cell from my experiment in January or February, 1916, where I tried out that whistle, until the item in Book No. 4 at page 179, under date of July 29th, 1919, where I referred to the use of the PE cell for photometric measurement of light on a motion picture screen. There is some discussion here about the dynatron and its characteristics, but nothing with respect to the combination of the photoelectric cell and the dynatron. The dynatron per se has nothing to do with the PE cell as a PE cell. I did not find anything in my notebooks on sound recording from the item of February in 1916, in Book No. 3, down to page 207 of my Book No. 4, under date of December 23d, 1920, when I say that I had a talk with Mr. Blank—meaning Mr. Hoxie—on the illumination of the oscillogram. I think we went over that during the lunch hour and found that there was no reference to the recording. And even at this date, December 23d, 1920, all the notebook shows is an item that I talked with Mr. Blank on the illumination of the oscillogram. That is what the notebook shows. That oscillograph is the instrument for recording sound. And then again referring to the notebooks, there was no further actual use of the PE cell for sound reproduction from the time of my experiments with that whistle in 1916. I haven't gone over the notebook very carefully after March, 1921. We found nothing in it up to that date. I testified to no use of the PE cell for sound reproduction with regard to my notebooks since that whistle episode.

Counsel states that I referred to some uses of the PE cell, or to which the PE cell was put, such as

measuring the density of positive and negative motion picture film and determining the lack of alignment of a vessel's shaft, and one or two other items. Some of those applications came in before this time, before the time that I talked with Mr. Hoxie.

XQ. 156. That is, the illumination of the screen was a photometric use which came in before you talked with Mr. Hoxie?

A. Well, there were several of those applications suggested before that time, and many of them were tried out.

As to whether they were all of the photometric use character, I would not say that the strain in the shaft was strictly photometric. If by means of the measuring of light by the photoelectric cell the strain in the shaft was determined, then it was not strictly what we should call a photometric measurement. It did not involve the matter of any use of varying frequencies of light. And the burglar alarm did not either. It was just a matter of the light falling on the cell and making it respond.

In one of my experiments I referred to the fact that I was not able to get any response out of the PE cell until I removed the slit from in front of the light source. I remember such an experiment. There were probably a good many of them. I find on page 72, first book, under date of the 27th of January, 1916:

> "Focussed the arc directly on the slit and then interrupted the light 125 times per second. A telephone in series with 125 and 250 volts, and the photoelectric cell gave no sound, though quite loud with the slit removed."

That is, with an arc light shining on the PE cell through a physical slit and with the telephone receivers at my ear, I was not able to get any response

until I removed the physical slit out of the path of the light to let more light come through. These uses of the PE cell for the burglar alarm and the measuring of illumination on the screen, and these other uses that I referred to other than the sound reproduction, did not involve any reproduction from sound film.

Page 58 of the first notebook says under the date of the 28th of December, 1915:

> "There certainly seems to be something the matter with the present dynatron. The characteristic curve is all right, but for some reason the oscillations are not."

I meant by that that they did not exist. The use of the PE cell referred to under date of February 20th for the calibration of the lamps was also a photometric use.

I referred or stated that Mr. Hoxie was recording sound on film, and I made that statement in connection with the date of about January 20th, 1921. I won't be sure that it was this particular time that I personally saw Mr. Hoxie recording the sound on film, but I know that either at this time or before this time I had seen Mr. Hoxie's apparatus; in fact, I had gone over the photoelectric cell setup, but I would not be sure that this was the exact date. Whatever work I did do in connection with the photoelectric cell for sound reproduction was work done in the laboratory of the General Electric Company. Counsel states that that work ceased some time in 1916 and that I did not pick it up again. I did not do any further reproduction of sound. You see, the laboratory is only interested in taking a job to the stage where it can get some other branch of the work to take it, where it gets to the point where we can show a way of doing it and provide an apparatus for it.

The General Electric Company maintains a very large patent department. It may be customary in that company to patent things when they reach the stage of experimentation where it is found that the experimentation is satisfactory. Sometimes it is, but it is not always done at once or for some time. Why, not more than a year ago I had assigned a patent to the General Electric on work I did back in 1920. It is customary to have these things referred to the patent department by the development people. I don't know whether I referred any of this work to the patent department. I have no note of it.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I do not know what is shown in this patent to A. W. Hull, No. 1,313,187. The circuit has a photoelectric cell in it. I should say it was a dynatron circuit. I am not quite familiar with the symbolic notation of the dynatron. I should say that this was the plate. If I understand correctly, the notation, the photoelectric cell is connected to the plate circuit of the apparatus, in which case it must be a dynatron, otherwise it would have been put on the grid.

(Patent to Hull, No. 1,313,187, applied for November 8th, 1915, received in evidence and marked Defendants' Exhibit 41.)

Mr. Ward referred me to Mr. White coming down and changing my arrangement. That change had nothing whatever to do with trouble with the photoelectric cell itself. Mr. White had done a good deal of work on various amplification circuits in his pliotron work. The outside circuit was his specialty, and of course that is a very important part of any amplification problem, the outside circuit. So we appealed to him to give us the best circuit that he could ar-

range to use in connection with this pliotron, and that was what he did and that was how we got this large amplification which I mentioned.

I am asked to state briefly the relation between the research department and the general engineering department. I don't know exactly what is called the general engineering department. There are four or five laboratories of the General Electric Company. Others might answer that much better than I can. There was the research, standardizing, engineering laboratory—I don't know. Mr. Hoxie was in the standardizing laboratory. He was not in the research department.

The work that I took up when Mr. Orange was leaving started out to be a determination of the best optical system for the 900-watt motion picture lamp that the G. E. had just started to make at that time, but before we had gone very far, we found that some system of recording photometry was necessary, and that was the way in which this photoelectric cell came into that work. And through this lamp we became involved more or less with the lamp works, and their photometry problems, and we applied this also to them.

I knew why Mr. Hoxie wanted information on the oscillograph when I spoke with him first. He was receiving signals over—I think they were cable signals, I am not quite sure—in which he had a pen recorder. That pen recorder, as is well known, involves the motion of a pen, either dot or dash, to signify the currents that came over the cable. They were very weak currents, and he wanted some way of increasing those, and we talked of the photoelectric cell as one possibility. That involved for maximum sensitivity, a maximum illumination in the cell for his normal position, so to speak.

My testimony does not include all the work that was done by the General Electric Company on photo-electric cells prior to March 24th, 1921. I have not made any attempt to collect all information as to all the work that may have been done.

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WILLIAM C. DURYEA, resumed the stand:

CROSS-EXAMINATION.

By MR. WARD:

This machine which I have testified about, Defendants' Exhibit 36, was not designed for the purpose of making a photographic record of pressures in internal combustion engine cylinders. It was not designed for that. It was used for that. It was designed for the purpose of recording high pitch vibrations. High pitch vibrations of any kind. The pressures in an internal combustion engine cylinder are not necessarily high pitch vibrations. They are high pitch, after a sense, but not as high pitch as some other vibrations. There are probably ten or fifteen vibrations between a set of lines which correspond to one one-hundredth of a second. The lines correspond to one one-hundredth of a second. The instrument has been used a good deal for determining the rate of change of pressures in internal combustion engines. I am not familiar enough with the description to say that is the use in connection with which the patent describes the device. I am a co-patentee. I signed it, but I have forgotten how the patent describes the device. It is a fact that at one time there was apparatus on this device for the purpose of measuring the rate of change of pressures in internal combustion engines. And that is not on here now. It is not an integral part of that apparatus. It is a distinct piece. It was taken off when we concluded the tests on that

particular motor. It might have been in 1921 that the Hupp Automobile Company obtained one of these machines for their use. I am telling you as well as I can recollect. Probably in 1921 or 1922, that is my recollection. I do not know definitely what year it was. I cannot state what year it was used by the Hupp Company.

The flywheel rotates at half the speed of the drive. The machine is adaptable to the use of paper strips or films. I have used ordinary motion picture film on it. I do not find anything in this notebook of mine except strips of paper. Professor Trowbridge has written articles about this machine. I am not sure whether there is any reference to films in there.

A piece of motion picture film fits in that machine. And it will operate with it in there.

The paper strip of material is fed to the apparatus in the following manner: the roller that feeds the strip of paper is a smooth surfaced roller, numbered 92 in the patent, that feeds the strip of paper is a smooth surfaced roller, numbered 92 in the patent—between which and another smooth surfaced roller—No. 93—the paper is passed. The roller 93 is an idler, and is spring-pressed against the driving pulley. The same structure is in the model. And the strip is passed tangentially to and between these two rollers. The strip is then cut off in relatively short lengths and passed between two other rollers, Nos. 106 and 107. And these rollers numbered 106 and 107 feed this short length of paper strip after it is cut off at a different and lower speed than the speed at which it was fed past the lens by the rollers Nos. 92 and 93. I won't say the piece of the strip in the lower part of the machine is travelling at approximately half the speed of the piece of strip in the upper part. It is travelling at a rate sufficient for the developer to produce the proper development of the

film. It is a very materially lower speed. The paper strip in passing the line 64, is pressed by a metal plate 91 against a pair of felt pads, one above and one below the lens.

XQ. 96. The parallel lines shown on Figure 20 of the drawing of the patent are reference lines with respect to time?

A. Those are reference lines.

Those parallel lines are photographed on the paper trip. These lines are photographed on the strip a definite fraction of a second apart rather than a definite distance. If the speed of the paper strip happens to be faster at one time than another, the parallel reference lines will be further apart, and if the strip moves slower the parallel lines will be closer together. That will make no difference in the use of those parallel lines for reference lines. They remain one one-hundredth of a second apart. And the curves on the strips of paper indicating the rate of change in the pressure of the engine cylinder at any moment will bear the same relation to those reference lines, whether the feed of the paper slip is relatively slower or relatively faster. The function of the parallel lines is to show the time interval between the changes in the pressure of the engine cylinder. These lines will correctly show the time interval in the pressure curve regardless of the variations in the speed of the apparatus. The record is not a sound record but merely a record of rate of change in the pressure of the cylinder.

XQ. 110. And I suppose you will not dispute the fact that in these records in your notebook here these lines, even in the short lengths that you have them here—three or four inches long—there actually is a variation in the spacing apart of those lines showing irregularity in the speed of the film. Have you ever measured up those?

A. This might have been taken at the beginning of the record. When the roll of film has started in motion there is always a slowing up for a very short distance; and after the roll of film has gotten up to the proper speed, it ran through at approximately a uniform rate.

XQ. 112. An approximately uniform rate is really all you care about in this device, isn't it? You said it did not make any difference?

A. Not for our purpose.

XQ. 113. No. And if there are variations in these lines on these short strips—that is, in the spacing of these lines, it shows that the machine speeds up and slows down within the distance of that strip of paper, does it not?

A. I would hardly think so.

I say, if the spacing shows a difference,—if it does. That would be the indication if it does. After the machine has gotten the roll of film in motion.

This is an article by Professor Trowbridge, "Photographic Recording of Engine Data." That article is with regard to this machine. The following statement from the article is correct:

> "A series of fine lines reaching clear across the paper is photographed at the same time as the record. These lines are spaced .01 second apart, even if the speed of the paper should vary slightly, and serve as time lines to time accurately an event shown on the record; for example, the opening of the exhaust valve."

I made reference to the fact that this machine had been used at some time to record sound. We made certain experiments. Professor Trowbridge attached an arrangement onto it, it was a microphone, the telephone, and it was hooked in connection with—— I helped him. I helped him with the experiment. And

we recorded musical notes, a tone, a long sustained tone from a trumpet. And we also spoke into this telephone receiver. The experiment was just playing. It was laboratory play work, just testing out the capabilities and the possibilities of the machine was all it was done for. Laboratory play work is what we would call it. We did not attempt to make commercial use of it. I don't think I have got any of those records. Because I only have one out of three and possibly four notebooks.

XQ. 126. What was the time that you tried this plaything that you talk about?

A. Along perhaps in 1920, 1921; along there. Not in 1923 or 1924. Professor Trowbridge was not in Princeton at that time. We have no records of that. We recorded the tone the same as we recorded the work done on the gasoline engine. We recorded it.

XQ. 131. Now, how do you know what the tone result of your record was? Did you reproduce it to see if you did record the tone?

A. No, indeed. We had no means of doing it.

XQ. 133. So all you have got for this plaything that you and Professor Trowbridge tried out was some kind of line on the paper strip?

A. Yes, sir. We never reproduced it.

The development of a strip in the bottom of the tank takes perhaps a half a minute; not longer. I would say less than half a minute.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I blew the trumpet in this experiment. There were high-pitched components in the gasoline engine test records. As to whether you could see them on the paper, apparently that is one of the earlier—one of the earliest books of record. After we had gotten

more light we were able to speed the machine up and widen out the time lines to a half or three-quarters of an inch. Then the high-pitched vibrations appeared more clearly. My recollection is that we did that about along in 1920.

RDQ. 141. Could you see the sound records that you recorded on the paper?

A. Yes, sir.

RDQ. 142. Do you—could you tell whether they were accurate recordings or not?

A. Why, yes. Of course they duplicated each other, the conditions.

RDQ. 143. Could you see the vibrations of the sound on the paper?

A. Yes, sir.

We were able to spread the time lines apart to a distance of about five-eighths of an inch. Five-eighths of an inch corresponds to .625, and that is a hundredth of a second: so a hundred times that would be 62½ inches per second. That was the best we could do. Bring it down, you could lower the speed until the time lines were not more than one sixty-fourth of an inch apart, or lower. We operated the machine at all different speeds. It depended on the sort of a graph that he was taking. Well, I remember speeds where the time lines were not over an eighth of an inch apart, graphs where they were a quarter inch, three-eighths inch, half inch, up to five-eighths; and at five-eighths, after we reached a speed beyond five-eighths, we lacked sufficient light for proper exposure.

The circumference of the roller over which the film passes is approximately one inch. I do not know what is meant in the article of Professor Trowbridge, referred to by Mr. Ward, by the fact that the speed might vary slightly.

I stated in my direct examination that the speed of the cylinder—or roller—was approximately uni-

form. As to what I meant by approximately, well, it has not the accuracy of a chronometer. For the length of film we took, which took but one second to put through the machine, I would say that the accuracy was high; very high. Because very little variation could occur in one second, in the speed of the machine.

With the time lines spread five-eighths of an inch apart the flywheel rotated at a high rate of speed.

RDQ. 158. Did the paper which you used shrink after it had been developed?

A. I am not sure; I don't know. It probably did. That is a characteristic of paper.

RE-CROSS-EXAMINATION.

By MR. WARD:

I haven't the least idea when I last used this machine for recording anything. That machine has been in storage for the last, I should say, ten or twelve years, if not longer. We probably quit the use of it right around 1921. Stopped the use of it around 1921 or 1922.

RXQ. 163. So it was only used in the Princeton laboratory for these experiments on these things?

A. No. The General Motors Research Corporation at Dayton, Ohio, borrowed the machine to do experimental work. I think it was in 1920. There is data here that will verify that statement. That is my recollection. That work was not for measuring pressures in engine cylinders. They were developing a new anti-knock solution to be placed in fuel for automobiles. I was told that it was a tetraethyl lead solution. I haven't any idea whether this device was used by them to measure the pressures in the cylinders in connection with the use of that gasoline. Mr. Midgley borrowed the machine, the research engineer, took it to Dayton, and did experimental work. I know nothing about it.

RXQ. 174. Now, will you please take these calipers and tell me what the middle diagram is in your

notebook, under date of June 21st, 1920. What does that show?

A. The shadow of the string. It is a record of four cycles of a gasoline engine, when indicating the explosion. The curve then indicates the rate of changes of the pressure in that engine. That is a properly made record.

RXQ. 178. Now, will you please take those calipers and place them so that they will stretch, say, four of those lines to the left-hand end of this strip, which is approximately six or seven inches long.

A. There is a variational curve.

RXQ. 180. Have you adjusted those calipers with your own hands so as to measure the width of four of those lines to the left of that strip that I referred you to? Have you?

A. Yes, sir. And it accurately measures the spacing.

RXQ. 182. And then if you move those calipers to of the center of the sheet and applied them to the space of the four lines at the center of the sheet——

A. The dividers are clumsy.. The calipers now correctly measure the width of the four lines at the left-hand side of the picture. There is a slight variation.

RXQ. 186. Now, I ask you to look at a curve in your notebook under date of June 21st—no year given —entitled "Characteristic of String for all of above." Is that the curve of your instrument? That is not an engine curve; that is the characteristic curve of your galvanometer, isn't it?

A. That is the characteristic curve of our galvanometer used on that instrument. I note a number of vibrations in the curve extending between the two adjacent parallel lines. It probably indicates the free period of the string. I am not sure. It indicates oscillation for the free period. In the string itself, I think.

RXQ. 192. And if you use that you record sound on, it would play havoc with the sound, wouldn't it, accurate recording of sound?

A. Those oscillations are probably due to the fact that the string was not sufficiently taut. I have got a curve here characteristic of my own instrument.

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HENRY A. TAYLOR, recalled, for further re-direct examination, testified as follows:

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I have now had sent up to me from Orange all of the drawings listed on Exhibit 19. I received them at ten o'clock last night. They are all the original tracings listed on that exhibit. I have examined them to determine that fact. This is the envelope in which they are kept. The title is Ediphone Recording Machine.

MR. ASHTON: Note for the purposes of the record that the group of drawings include 64 drawings, numbered from 1 to 64, the assembly drawing No. A-896, which is already in evidence as Defendants' Exhibit 17, and a drawing entitled on the material list "sub-assem."

THE WITNESS: The drawing last referred to is, as I stated yesterday, a sub-assembly drawing. It shows the thread spotting device. That is very necessary when recording to start your stylus at the proper point, and this is an accessory to the machine and is used for proper location of the stylus. It was not a substitute for the drawing A-896, the assembly drawing. It was a sub-assembly.

RDQ. 398. Now, have you examined these drawings, 66 in number, for the purpose of determining

whether or not you made the machines in accordance with these drawings, the six machines that you have testified you built?

A. The machines were made from those drawings —from blueprints of those tracings.

MR. ASHTON: I offer the additional 63 drawings in evidence and ask that they be marked, beginning with the marking 19-B, and that Exhibit 19 be remarked as Exhibit 19-A, the letters to continue, doubling if necessary, to complete the exhibits under 19-A and so forth.

(Sixty-three sheets of drawings comprising sub-assembly and detail drawings of Edison Kinetophone—witness Taylor — marked respectively Defendants' Exhibits 19-B to 19-KKK.)

This is a correct sketch of the Kinetophone reproducing machine, Exhibit 11 in this case. I have examined the machine for the purpose of determining that this sketch is correct.

MR. ASHTON: I offer the sketch in evidence as Defendants' Exhibit 42.

(Taylor sketch of Kinetophone reproducing machine received in evidence and marked Defendants' Exhibit 42.)

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OSCAR STEINER, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live in Media, Pennsylvania. I am with the Bartol Research Foundation as chief mechanician. That is a subsidiary or associated society with the

Franklin Institute, doing research work in physics. The Franklin Institute is a scientific organization in Pennsylvania, located in Philadelphia. I have charge of facilities, design of apparatus and construction of apparatus necessary for research work. I have been employed there about ten years; since 1923.

I worked for the General Electric Company from 1917 until 1923. I was primarily employed, or my official duties was model maker in the General Engineering Laboratory, in Schenectady.

This is a machine which I built for Mr. Hoxie originally; camera and reproducer for sound on film. Mr. Hoxie was an engineer in the General Electric laboratory, in Schenectady. I built this machine. I finished it in January, 1921. I know it was January, 1921, because I verified that from the records of the company. The parts of the machine which are original parts are the box itself with the lid, the film track. The box, by the way, was square at that time. That is, the corner has been cut out. It has been cut off when it was converted to become a film attachment for the oscillograph. The film track, the bearings, the upper idler, these idlers, the track in the back, the takeup pulley. That is all the original parts. I can describe the machine as it was when I finished making it in January, 1921. There were two reels, the upper reel which carried the film was mounted on a shaft which rotated in what was then a bearing. The old bearing has been converted into a patch to cover the hole. The film passed through an idler roller, through the film track, through a knife-edge slit mounted in front of the box, and over a sprocket sized to this idler, over this idler here to the lower reel. On the shaft which carried the sprocket was mounted an oscillograph flywheel such as this one, which was a standard article around the laboratory.

(Camera identified by Steiner marked Defendants' Exhibit 43 for Identification.)

(Oscillograph flywheel and attached motor referred to by Steiner marked Defendants' Exhibit 44 for Identification.)

I think I mentioned I put a flywheel on, a similar flywheel to this one, that is, the flywheel, Defendants' Exhibit 44 for Identification. And in the rim of the flywheel was mounted a handle obtained from a small knife-switch, which served the purpose of rotating the apparatus by hand.

For recording, the knife-edged slit was adjusted by means of a micrometer. Immediately in front of the slit was a cylindrical lens, thence a vibrator which was made out of mica, a moving element attached to the mica diaphragm, and which carried a mirror. A locomotive headlight was focussed through a condenser on to the tiny mirror which was set into lateral vibration by the sound waves of the speech and covered more or less of the slit. The adjustment, to start off with, was made by having a narrow rectangular spot of light, the edge of which was at the center of the slit. For reproduction a photoelectric cell which was in a housing was placed immediately in front of the slit. Again, the locomotive headlight was focussed through the back of the box, through the film, and through the slit onto the photoelectric cell. The cell operated directly on a grid of what was then known as pliotron—that is what we knew it by—and the head phones were in the plate circuit of this pliotron.

The lower sprocket, being of the same size as the upper idler, was placed so that the sound track here, formed a tangent to the periphery of the sprocket, and there is still some evidence where this later on was patched up. You cannot see it here. This entire assembly was moved over.

MR. ASHTON: Note that the witness has pointed to the cut-out portion of the box, and the holes which have been plugged up.

I saw recording and reproduction done on this machine immediately after it was finished. It was in the middle of January. I have stated that the machine had a flywheel on it and that the flywheel was hand-driven. The flywheel was rigidly mounted on the same shaft with the sprocket—the takeup, rather, on the same shaft as the lower sprocket. They were rigidly mounted together.

A change was made in this apparatus in 1921. The first change which was made was to cut a groove in the flywheel, which already existed on the box, and take a unit identical with this one, Exhibit 44, to drive it. The driving was by means of a belt. The camera was placed on the laboratory table and the motor was on the floor, and a long belt coming up around the groove in the flywheel pulley.

Q. 32. You stated, did you not, that the flywheel which you put on the camera and the flywheel which was on the motor shaft were standard oscillograph flywheels?

A. Yes.

Q. 33. And that the motor was a standard oscillograph motor?

A. Yes.

Units of this type were kept in stock in the General Electric Company plant and were used generally around the laboratory for all kind of drives. When we hooked it up for power drive we added something else to the machine. At the same time we substituted moving picture camera magazines, for the reels. They were wooden magazines of a smaller type. They were the forerunners, of this type of magazine, that is, the type which is on the machine now. They were made

of wood and held by two screws coming through the back of the box. Immediately after completion I saw the machine used with a motor drive. This was a few days after the first drives were made.

This is a reproducer which was built for Mr. Hoxie for sound on film. I started to work on this machine and got the parts together and had a layout made up for it practically in my mind, and Mr. Tschopp helped me. He was another model maker working right on my side, started to help me about the 10th of February, 1921. We were working side by side, and the machine was completed in about six weeks. I would say it was completed around the first of March, 1921. The work was continuous. Mr. Hoxie created quite a sensation with the first film, and everybody wanted to listen to it, and we were very hard pressed to complete the reproducing apparatus. The motor, belt, lamp housing, lamp, photoelectric cell, probably the tube, the vacuum tube, or pliotron as we called it, and the governor are not original parts. I know that the motor is not the original because the original motor was 115 or 120-volt motor, and this is a 10-volt motor. We had 120 volts d. c. available in the General Engineering Laboratory, which was very unsteady. The motor now on the machine operates on 10-volt d. c., battery probably. That is, batteries would be used ordinarily in running that motor. It is about the only source we would have for ten volts, d. c.

This machine had a governor on it when it was completed. It had a different type of governor on than the type that is shown there now. It was the conventional type three-ball governor, and the parts of it were obtained from an old Dictaphone governor, heavier springs and much larger balls were used. The supply of power, as I stated before, was quite unsteady, so in order to obtain a uniform linear velocity, uniform velocity past the slit, we had to have quite

uniform rotation of the sprocket. Now, the motor was run at a faster speed than was actually required; it was overrun, the belt slipped and constant slippage was obtained by this spring idler here, and the governor, which was of the brake type, acted as an escapement for the large heavy gear. The speed of the governor as compared with the speed of the gear was in the ratio of seven and a half to one.

The purpose of the arrangement to which you are pointing is to retain a constant pressure on the belt. This idler here retains a constant pressure on the slack side of the belt, it is spring-pressed.

The governor now on the machine performs, you might say, one additional function over the original governor, in that it acts as a—it has a flywheel effect. The governor was carefully adjusted to the speed it was run or supposed to be run, and then locked and carefully balanced.

Q. 57. Did the original governor have a flywheel effect?

A. It had a flywheel effect, but it was forever unbalanced. It was quite difficult to balance the governor.

I made the governor now on the machine. It was a part of an obsolete tachometer. A tachometer is an instrument for measuring revolutions per time unit of a rotating member. These devices were used very frequently in the General Electric factory. To state what I did to convert the tachometer governor to the governor now on the machine, the moving element, the rotating element of the governor, was very carefully rebuilt, and a helical gear to match the large helical gear was mounted; and the governor was also very carefully, as I stated before, carefully balanced at the position it was to be run. The new connection was made and put on the machine about July, 1921.

(General Electric reproducer identified by Steiner marked Defendants' Exhibit 45 for Identification.)

To point out quickly how the machine was used to reproduce sound on film: The film, which was wound on this here reel, was threaded over and around the photoelectric cell housing and passed through this sound track, or film track, the gate of which contained two knife edges adjusted by a micrometer, thence over and around a sprocket similar to the sprocket used on the camera and reproducer, the sprocket again being mounted rigidly on the same shaft with the large gear. Thence around this one idler and around the take-up reel. The lamp was contained in this housing, and the cylindrical lens here focussed onto this slit. The light went through the film and onto the photoelectric cell. The photoelectric cell was mounted in this container and acted on the grid of the pliotron.

The photoelectric cell which you show me looks very much like the photoelectric cell originally used in this machine. I recognize it by the old type target.

(Photoelectric cell was marked Defendants' Exhibit 46 for Identification.)

I believe I testified that the lamp, or the locomotive headlight, the pliotron and cell in the machine now are probably not original; by accident they might be the same. The tube you show me is similar to the tube originally used in the machine. It is the pliotron tube, three-element vacuum tube.

(Pliotron tube was marked Defendants' Exhibit 47 for Identification.)

I refer now to the original machine which was marked for identification, Defendants' Exhibit 43, the motor-driven flywheel which I have testified was placed on this machine was removed at one time, and a gear and ball governor was substituted for the flywheel.

Q. 75. Was this done while the machine was being used for recording sound on film?

A. Yes, it was done later on, in July, 1921, sometime. A gear similar to the gear on the direct reproducer was fastened on this shaft, and the governor was mounted on here, and these rivets here were later put in, the holes which these rivets covered up were used to mount the governor bearings. The original governor was a fly-ball governor. It was similar to the governor which I have testified was originally on Defendants' Exhibit 45 for Identification. Records were recorded on the camera, Defendants' Exhibit 43 for Identification, after the gear and the governor were substituted. The records were not satisfactory, though. The governor had a tendency to introduce vibrations in a horizontal direction, to the entire mechanism. The governor was put on the machine because the line voltage of the laboratory was so bad at times that we tried to resort to better means to improve the original arrangement. I am referring now to the hand-crank flywheel and the power-driven flywheel. I would like to state that one additional reason for using the governor was to get a uniform rate of speed over the entire period of the record. We put the governor on to create just this condition, as I said before; and to be able to overrun the motor, the governor acting as a definite escapement for the main shaft. If the motor was run faster than was required, the governor definitely fixed the maximum speed of the main shaft; so if small variations by the motor were introduced, they did not affect the main driving shaft. We expected better results with that than with the variable power arrangement which I have testified we got with the motor drive and flywheel.

I last saw the machine, Defendants' Exhibit 43 for Identification, before I came to Scranton, in Swarthmore; it was brought to my office. It was

brought from Philadelphia, the G. E. plant in Philadelphia. I brought it to Scranton. Before I saw it in Swarthmore the last time I can definitely say I saw it is when I converted it into a film adapter for the General Electric oscillograph.

The oscillograph department wanted to make a record of a long time, and the standard film holders were only large enough to accommodate about one foot of film. So the knife-edge aperture was taken off and this plate here mounted for the purpose of sliding in it the standard plate film receiver of the oscillograph. This corner was cut off, to place some binding posts on the apparatus. A smaller sprocket was substituted here. The speed at which they used the film was considerably slower than anything we had used previously. I think it was an inch a minute. This counter was mounted and a sprocket for chain drive was put on. I did that part of the work. However, this standard here, which is for the purpose of taking some of the load of the camera so that the entire camera would not be on the front of the oscillograph, was put on by someone else, I don't know who. And aluminum film containers were substituted for the wooden ones. I made this conversion, I believe, around August, 1921. After I converted the machine I turned it over to the oscillograph department in the General Engineering Laboratory at Schenectady, New York.

CROSS-EXAMINATION.

By MR. WARD:

Referring first to Defendants' Exhibit 43 for Identification: In whatever condition this remaining part of the machine was in 1921, I finished it in such condition as it was about the middle of January, 1921. Then I changed it over to its present condition about August, 1921. And when I first finished it, it had a

large roller down here where the small standard 16 tooth sprocket now is. That roller was just like the large smooth roller up at the top of the machine with the exception that it was a sprocket roller of the upper roller's dimensions. The construction of this upper roller at that time was just the same as it is now.

When it was first built it had a flywheel on it. That was done before the machine was first used. I am saying that for this reason: that a crank was originally requested, and it is much easier to take a flywheel and put a handle on it than to make a crank. And I definitely remember that was on at the start. That is, when it was first constructed a flywheel was put on with a handle, a little switch handle which protruded from the outside rim to rotate it by. In other words, we had a handle screwed into the flange of the flywheel here to crank the machine. There was a hole tapped in here which had the crank handle. Another reason why this was used is because it had already the pulley for the take-up. It was a part already made. The crank handle was the only means by which to rotate. This machine as originally constructed was a manually cranked machine. I put the flywheel on and put the handle on to serve the purpose of a crank, of course. In that condition the machine was operated as a hand-cranked machine. It was used for making sound records. This Defendants' Exhibit 43 was also used as a reproducer, as a combination of the two. The film feed arrangement in both cases was exactly the same.

The hand crankshaft carrying the flywheel on this machine was at the lower sprocket. It was on the main driving shaft; that is the only rotating shaft in this machine. And this upper smooth roller was simply to guide the film past so as to get it in alignment with the gate here.

XQ. 125. And then in August, 1921, as far as your memory goes, you changed that over and took off the flywheel and put on governors?

A. That was not in August. I think that was in July.

XQ. 126. I thought you said August, July, 1921?

A. In August it was converted.

The putting on of the governors in place of the flywheel preceded my converting the machine as an oscillograph. We got better uniformity of speed with the ball governors than we got before. Because, as I stated before, the surges at times were very bad, the surges on the line voltage, d. c. line voltage at the laboratory. I am talking of when the governor was on and when the motor drive was on. The hand arrangement, the hand drive, was only used a few days. We had the hand driver on only for a few days. It was not taken off. We merely cut a groove in the wheel, in the outside face of the wheel, and then it acted as a pulley and flywheel combined. That was driven by a unit similar to the one over there.

XQ. 135. Then from January to August, 1921, you first had the hand crank and then you had the motor driven with the flywheel, and then you had the ball governors, you had those three constructions within the period of less than six months?

MR. ASHTON: January to July, Mr. Ward.

MR. WARD: No, I am giving the question.

A. You mentioned—I would like you to repeat the question. Before you do so, you mentioned August, 1921; did I ever mention that such a date?

XQ. 136. I think you did, Mr. Steiner. Give the correct date. Don't let me stop you.

THE WITNESS: Will you please repeat the question that Mr. Ward put?

MR. ASHTON: Repeat the question.

(Last question repeated.)

A. That is right.

Finally I converted the machine into the approximate form it now is. As to which gave the better uniformity of speed, the hand crank construction, the motor drive with the flywheel, or the motor drive with the governor balls, the motor with the last governor, I believe, gave the best reproduction.

XQ. 139. And that was the case where you had the flywheel off?

A. Ordinarily the flywheel with motor drive was quite good, unless these surges came in.

If the surges came in there was a momentary change in the speed, of course. And that affected the sound recording. And if the sound recording was affected when we recorded, we could detect that on some of the records that we made.

In this other machine, Defendants' Exhibit 45, the film comes off of the reel on the left-hand side of the machine facing the motor. It passes over a small smooth roller on the extreme left-hand upper end of the machine and over another one at the right-hand side of the frame carrying the first one and past the gate. The gate is on the edge of the housing here. And then the film passes through a slot in the main horizontal flat part of the machine. The clearance slot, I would call that. And then it goes to the left, facing the machine, of a fairly large sprocket tooth and it comes under that sprocket wheel. Then it goes over this roller on the right of it and it passes from that idler roller on the right to this windup reel. The main sprocket feeds the film through that machine. There is only one sprocket that feeds it. That sprocket does all the feeding. These others are guides and idlers. That large drive sprocket is on a shaft, and on the

outside of that shaft there is a wheel with a crank handle. It is a worm gear. I would like to state that the crank handle is only there for the purpose of threading the machine. The crank handle is not used to drive this machine, but just to help thread it. That wheel has a worm-tooth cut on the edge of it; it is a helical gear. That engages a helical pinion running tangential to the big wheel. The governor is on there. This thing that the crank handle is on is made of brass, I believe it was about five-sixteenths brass. In other words, this gear is cut in the brass. That was the reason for putting this pulley on. It facilitated the cutting of this gear. That is why that thing was made out of two pieces.

The governor on there now is considerably better balanced at the speed it is running than a three-ball governor. The machine as originally constructed had the fly-ball governors which moved out. When they moved out or came back in they changed the balance. It was very difficult to retain symmetry of the three balls and still have rigid construction. Although those balls did move in and out with the variations of speed, they had a flywheel effect, of course. Their moment of inertia changed from the center of the shaft as they moved out and in.

XQ. 178. Flywheels don't do that?

A. They do not do that. Yes, they do to a certain extent.

You have a certain amount of elasticity in your material from which you make the flywheel. I mean elasticity in a disc of steel. You necessarily have give in the material towards the periphery if gravitation, due to rotation, acts on it. This is a very highly imaginary and technical supposition. I admit that. But it was the only thing I could think of to contradict your statement that it was not a flywheel.

XQ. 183. Oh, you wanted to contradict my statement, so you went to that extent, did you?

A. I did.

XQ. 184. Is that right?

MR. WARD: He says "I did."

XQ. 185. So you went to the extent of trying to contradict my statement?

A. I mean to say, I did not agree with your statement that it was not a flywheel. Not "to contradict."

To get my analogy and contradict your statement I assert that in an ordinary piece of steel, a steel disc, there is elasticity in the metal which changes its moment of inertia as you rotate it. It will to a very, very slight extent, according to the elasticity of the material. It is negligible from a practical standpoint. I agree with you. The ball governor is by no means negligible, that moment of inertia changes the size of it as the balls move in and out. It depends on the sensitivity of the governor. That kind of governor we had on there, I would say, in the speed range in which we used it, the position of the ball from the center of the shaft changed very little because they were large balls. We changed it because the balance could not be retained as well as with this type. And the balance could not be retained because they had this slight movement.

MR. NEAVE: Had what movement, Mr. Ward?

MR. WARD: The in-and-out movement he talks of.

MR. NEAVE: Did you hear that?

THE WITNESS: On the ball governor, yes.

We had decidedly better results after we took those ball governors off and put this one on. The governors we had there before did not give us satisfactory reproduction.

We made the change from the ball governors to the governor we have on here now about the middle of July, 1921, the same year we were working on the camera. When we had the ball governors we did not have any additional flywheel than which you see there. We relied upon the ball governors with the flywheel effect plus the weight of the gear. The gear is a considerable mass. I think this gear was made out of five-sixteenths brass stock. It looks quite narrow here, because of the teeth, it tapers out.

XQ. 202. And the flywheel effect, so to speak, of that type of gear would not have very much function contrasted with what your ball governors would have that you had on here originally, would it? The ball governors would be the controlling effect in the speed?

A. Absolutely, in both cases, with this governor, as well as with the other one.

The earliest date that this machine stood in the condition it now is in was July, 1921. I believe that is the time we changed the governor. I finished this machine in March, 1921. I believe it was the first part. It could not have been later than the 16th.

XQ. 208. Why do you say that?

A. No. Wait a minute. I beg your pardon. The middle of March.

XQ. 209. Why do you say the middle of March?

A. We had been getting together on it, Mr. Tschopp and I, and we both independently came to the conclusion that is about as long as it took us.

XQ. 210. You and Mr. Tschopp had been getting together on it? And you both independently reached the conclusion that it did not take you any longer than the middle of March, 1921?

A. Maybe I didn't state that just right. We asked each other the question, "How long did it take?" I started very shortly after that job there was done;

and he came in on, I believe it was, February 10th, and I know, I well remember, that we were hard pushed to get the thing out, because people wanted to listen to the film.

The only way I can say that I finished it by the middle of March, 1921, was by estimating the amount of time that it took me to build it from the time I started. If I have been told that the date of March 24th, 1921, was a rather important date in this suit, I have forgotten. There is no effort on my part to fix the date certain by the middle of March, 1921.

XQ. 215. It just happened that you decided that was about the date?

A. We agreed that it took about six weeks to build it.

XQ. 216. Will you swear that the machine was not finished——

A. I beg your pardon. Did I say March?

XQ. 217. Yes, you did.

A. I would like to make the statement that this machine here could not very well have been finished later than, I think it was, April 16th.

As a matter of fact, I know that the machine, Exhibit 45 for Identification, could not have been finished later than April 16th.

XQ. 221. "Not later" does not do us much good. Are you prepared to say it was finished before April?

A. I believe it was finished about the middle of March; between the middle of March and the end of March.

XQ. 222. And your best recollection is between the middle of March and the end of March, but it might have been in April? It might have been as late as April 16th?

A. I know it could not have been later than April 16th.

Tschopp's book shows that we finished the job at that time. That is the time he went off the job.

I believe I filed some patent applications while I was with the General Electric Company, on the subject of sound reproducing. I am the Oscar Steiner mentioned in Patent No. 1,817,781, filed July 5th, 1927.

(Steiner Patent No. 1,817,781, marked Plaintiffs' Exhibit 35 for Identification.)

You show me a photostatic copy of the file wrapper and contents of an application, Serial No. 203,353, which is the serial number of the patent I just referred to. That is my signature at the bottom of that oath there. That application was filed in my name.

(File wrapper and contents of Steiner Patent No. 1,817,781, marked Plaintiffs' Exhibit 36 for Identification.)

I did not follow the prosecution of that application after I filed it. As to whether any of the rejections of the claims were referred back to me, I cannot remember whether there was anything more done about that or not. I cannot offhand remember. I believe I read over the specifications and claims of that application before I signed the oath and filed it.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

RDQ. 232. I believe you stated in connection with Exhibit 43 for Identification that the film was travelling in some of the recording or reproducing at an inch a minute.

A. I was talking about the oscillogram. I meant to indicate by that sprocket that was on there.

When this camera was operated in 1921 we tried to maintain standard motion picture speed, which was,

I think, a foot a second—no, twenty-four pictures per second, eighteen inches. Is that correct?

RDQ. 234. I did not ask you, but will you now state whether the gear arrangement which you applied to Exhibit 43 was the same in weight and size with the gear on Exhibit 45, or different?

A. The arrangement was the same on 43 as it was in 45 later on.

To describe a little more in detail the ball governors which I used on the two machines: In principle these connections were exactly alike, the conventional phonograph governor. We put strong springs in. We had to, by reason of the heavier ball. Those governors, the ones we had on the machine were unbalanced. And that was largely due—if we took a heavier spring, a spring sufficiently strong to keep the ball in correct position to retain balancing, good balance, the spring was away too stiff to work in the range we wanted. We just could not balance them properly.

RDQ. 238. That applies to those particular ones?

A. It does.

RDQ. 239. You don't mean to say that phonograph balls are unbalanced?

A. Not at all.

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Room 401, Jermyn Hotel, Scranton, Pa. Same appearances.

MR. NEAVE: Your Honor, at my request, we met this evening in a room at the Jermyn Hotel to hear the defendants' demonstration of certain sound records and sound reproducing apparatus that have been or will be put in evidence in this case. In this room in which we are, there are present your Honor, the clerk of the Court and the Court Reporter. Also representing the plaintiff there are present Messrs. Ward, Haselton, Mattes, Ballard and Engl; and representing the

defendants there are present Messrs. Ashton, Waterman and myself, and Dr. Kellogg. Also there is present Mr. Mallina, and a telephone connecting to the adjoining room, so that he may readily during the demonstration communicate with that adjoining room, as Mr. Waterman may direct.

The only apparatus other than the telephone in this room is an ordinary modern Radio Corporation loud speaker, such as is used in theatres.

From this room in which we are leads a short corridor, which may be closed by folding doors to that adjoining room. In that room are all of the apparatus and records to be demonstrated, and men who stand ready to put one or another record or piece of apparatus in operation. Also I have asked Mr. Ward to have representatives in that room to observe the records and apparatus throughout the demonstration. He tells me that those representatives are Mr. Joy and Mr. Daggett. Mr. Barnes is also observing there for the defendants.

The defendants have prepared a definite program, typewritten copies of which have been handed to your Honor and to the others here present. Also Mr. Ward's representatives in the adjoining room have copies. That program is as follows:

PART I EDISON KINETOPHONE — Mechanical Reproduction

1. Watson Record.
2. Minstrel Record.

| Part II Comparative Tests | | Electrical Reproduction |
|---|---|---|
| **First Test** | | |
| 3. P. S.-1 | film | Speech |
| 4. P. S.-1 | disc | Speech |
| 5. Edison "Kinetophone" | large cylinder | Speech |
| 6. Edison "Triumph" | small cylinder | Speech |
| 7. P. S.-1 | film | Waltz |
| 8. P. S.-1 | disc | Waltz |
| 9. Edison "Kinetophone" | large cylinder | Waltz |
| 10. Edison "Triumph" | small cylinder | Waltz |
| 11. P. S.-1 | film | Piano |
| 12. P. S.-1 | disc | Piano |
| 13. Edison "Kinetophone" | large cylinder | Piano |
| 14. Edison "Triumph" | small cylinder | Piano |
| 15. P. S.-1 | film | 512 Cycles |
| 16. P. S.-1 | disc | 512 Cycles |
| 17. Edison "Kinetophone" | large cylinder | 512 Cycles |
| 18. Edison "Triumph" | small cylinder | 512 Cycles |
| 18A. Edison "Triumph" | light weight small cylinder | Speech, etc. |
| **Second Test** | | |
| 19. P. S.-16 | film | Speech |
| 20. German early flywheel patent No. 387058 | film | Speech |
| 21. P. S.-16 | film | Waltz |
| 22. German early flywheel patent No. 387058 | film | Waltz |
| 23. P. S.-16 | film | Piano |
| 24. German early flywheel patent No. 387058 | film | Piano |

| | | |
|---|---|---|
| 25. P. S.-16 | film | 512 Cycles |
| 26. German early fly-wheel patent No. 387058 | film | 512 Cycles |
| THIRD TEST | | |
| 27. P. S.-1 Damped | film | Waltz |
| 28. P. S.-1 Undamped | film | Waltz |
| 29. P. S.-1 Damped | film | 512 Cycles |
| 30. P. S.-1 Undamped | film | 512 Cycles |
| 31. Pure tone | | 1000 Cycles |
| 32. Patent in suit Fig. 5, Undamped Springs | film | 1000 Cycles |
| 33. Patent in suit Fig. 5, Damped Spring | film | 1000 Cycles |
| 34. Patent in suit Fig. 5, Damped Spring with shoe | film | 1000 Cycles |
| 35. P. S.-1 | | 1000 Cycles |
| 36. Patent in suit Fig. 5, AMET attachment in place of TRI-ERGON spring | film | 1000 Cycles |
| 37. Patent in suit Fig. 5, Constable attachment in place of TRI-ERGON spring | film | 1000 Cycles |
| PART III PRIOR ART | | |
| 38. Constable machine —SPRING FREE | small cylinder | Waltz |
| 39. Constable machine —SPRING CLAMPED | small cylinder | Waltz |
| 40. Edison Skeleton | film | Speech |
| 41. Bell and Tainter | film | March |
| 42. Dragoumis | film loop | Speech |

| | | |
|---|---|---|
| 43. Dragoumis | film loop | March |
| 44. Reel film | | Speech |
| 45. Reel film | | Waltz |
| 46. Hoxie machine and film | | Speech |
| 47. General phonograph | disc | Music |
| 48. Victrola | disc | Music |

The apparatus has been assembled and the program has been arranged under the direction and supervision of Mr. Waterman who, during the progress of the demonstration, will point out whatever may be necessary in addition to what is contained in the program, this being done as a part of his direct testimony in this case. I request that Mr. Waterman be permitted to carry through the demonstration without interruption. At the conclusion of the demonstration Mr. Waterman and plaintiffs' counsel and representatives, and, of course, your Honor, if you desire, may go into the adjoining room and examine the apparatus there. The plaintiffs' counsel and representatives may there informally ask Mr. Waterman any questions they may desire, and will be given full opportunity to examine the apparatus and circuits. If then they wish to ask Mr. Waterman any questions on the record, they will return to this room, where such questions may be put and answered.

I suggest that, in order not unduly to prolong this evening's session, Mr. Waterman be here cross-examined only on the points considered necessary to bring up while the operating circuits are before us. He will be on the stand in the court-room, and during his testimony will again refer to these demonstrations, so that he may be further cross-examined there.

Now, may Mr. Waterman be sworn.

FRANK N. WATERMAN, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. NEAVE:

Q. 1. Mr. Waterman, the first item on the program is the Watson record, which is already in evidence, and which, according to the testimony, has been much worn by use. State on what machine it is now to be demonstrated, and then proceed to demonstrate and follow it with the other items on the program, making such statements between each of two items as may be necessary, in order that we may better follow the demonstrations.

A. The Watson record which is in evidence, and which is considerably warped and, according to the testimony, badly worn, will be demonstrated on the Edison Kinetophone, also in evidence, using mechanical reproduction with its regular stylus and mechanical sound box. As the record is not in at all good condition, I think perhaps you will prefer to stand in the corridor here to listen to it. The Minstrels record, which will be played following, is loud enough so that we can hear it very well in here.

(At this point the item marked No. 1 of Part 1 is demonstrated.)

THE WITNESS: We will now hear the second one of the Edison Kinetophone records in evidence, the title of which is the Minstrel record, also reproduced by the Edison Kinetophone in evidence, with the mechanical stylus and diaphragm.

(At this point the item marked No. 2 of Part 1 is demonstrated.)

Q. 2. What, Mr. Waterman, are the comparative tests we come to in Part II?

A. These tests are between the R. C. A. machine, known as PS-1, which is one of the alleged infringing machines, run both as a film machine, for which it is intended, and as a disc machine, for which it is also intended. That is to say, the machine is provided with not only the means for reproducing sound from a record on the film, but is also provided with the ordinary phonograph turntable upon which disc records are played, which accompany and are synchronized with the film in ordinary motion picture talking picture projection.

We will compare with these two renditions of PS1 machine the Edison Kinetophone and the Edison Triumph machine, both of which are in evidence and which are designated here as "large cylinder" and "small cylinder" machines. These tests are all to be rendered through the loud speaker in the room and through the R. C. A. amplifier which, in the theatre, feeds this speaker.

Since we are interested here solely in the matter of speed, I have arranged that all other variables shall be eliminated; that is to say, we will use for the Edison Kinetophone an electric pickup, the current from which will pass through the same amplifier and through the same loud speaker; and similarly with the Edison Triumph machine, the sound will be picked up by a so-called electrical pickup passed to the amplifier and rendered through the loud speaker here.

These tests are divided in four groups. Three, four, five and six will render speech. The next group, music, orchestral music; the next group, piano music; and the next test I will explain more in detail when we come to it. The records which are used for these tests have been prepared under my direction, and contain the first three subjects which I have mentioned, namely,

speech, waltz and piano, and are believed to be of uniform high quality recording, so that it may safely be concluded that such variations in pitch as may be noticed are due to the variations in speed of the reproducing machine in use at the time.

We will have now the tests 3, 4, 5 and 6, PS1, first with film, then with disc, then Edison Kinetophone with the large cylinder, and the small cylinder at the moment will be announced by lights on the board at the front of the room.

The word "film" lighted will mean that PS1 is operating, reproducing from the sound on film.

The word "disc" lighted will mean that it is the PS disc that is operating.

The words "large cylinder" or "large cyl." will indicate the Edison Kinetophone is operating.

"Small cylinder" means that the Edison Triumph machine is operating.

(The Item No. 3 is here demonstrated.)

THE WITNESS: We will now have the disc of the PS1 machine.

(Item No. 4 on program demonstrated.)

THE WITNESS: You are now hearing the Edison Kinetophone.

(Item No. 5 on program demonstrated.)

THE WITNESS: You are now hearing the small cylinder machine, the Edison Triumph.

(Item No. 6 on program demonstrated.)

THE WITNESS: That completes the first series of tests.

In the next series we will use the same machines and the tests will come in the same order, but music will be reproduced instead of speech.

(Item No. 7 on program demonstrated.)

(Item No. 8 on program demonstrated.)

(Item No. 9 on program demonstrated.)

THE WITNESS: Now we have the Edison Kinetophone playing the same selection.

(Item No. 10 on program demonstrated.)

THE WITNESS: Now we have the small cylinder, the Edison Triumph.

You have now had an opportunity, through the reproduction of speech and of music, to judge of the relative uniformity of speed of the PS1 in its two capacities, and the two Edison machines.

The next series, of four numbers, 11 to 14, repeat the same succession with piano music instead of orchestral music.

(Item No. 11 on program demonstrated.)

THE WITNESS: Now we are hearing PS1 on the film.

(Item No. 12 on program demonstrated.)

THE WITNESS: Now we are hearing the same on disc.

(Item No. 13 on program demonstrated.)

THE WITNESS: We now hear the same on the Edison Kinetophone, the large cylinder.

(Item No. 14 on program demonstrated.)

THE WITNESS: The same on the small cylinder, the Edison Triumph.

The next series of tests, beginning with No. 15, is a series put in for the benefit of those present who are experts in tests of this kind. They are tests that to the general public would mean nothing. They are given because those who are competent to judge of tests of this kind often use such records for the purpose, and know how to judge

them. For the benefit of those who do not, may I make a suggestion. These records are all recorded at substantially 512 cycles per second. That is the octave on the piano above Middle C. The records are accurate, but you will not hear them accurately if you do not listen properly. The room reflects. There are pressure nodes through the room. If you move your head while you are listening to these records, you will hear a changed sound which is not in the record, or if you move your position. If you move forward or back you will hear a change which may be interpreted to you as a change of pitch or a change of volume; so in order to hear these properly it is necessary to keep the head perfectly still.

(Item No. 15 on program demonstrated.)

THE WITNESS: You are hearing the film now on the PS1.

(Item No. 16 on program demonstrated.)

THE WITNESS: You are hearing the disc now on PS1.

(Item No. 17 on program demonstrated.)

THE WITNESS: You are now hearing the Edison Kinetophone.

(Item No. 18 on program demonstrated.)

THE WITNESS: You are now hearing the small cylinder Triumph machine.

I have interpolated at this point an additional test, and the point of that is this: it is stated in the patent in suit that disc and cylinder machines have the small irregularities smoothed out by the weight of the record itself, and that that constitutes a difference between the film machine and a disc or cylinder machine. There are several tests

on the program that go to this point. The one that I have here interpolated makes use of very tiny records, a little over an inch long and about one-eighth of an inch thick, that I have had specially recorded, which will be slipped on to the Edison Triumph machine, and whose mass is so trifling as compared to that of the normal record that it affords a fair test of the capabilities of the machine substantially without the benefit of its record weight.

I have two of these cylinders, both of which I can play. One is speech and the other is music. Unless it is desired to shorten the test by cutting out one of them, I will ask that they be played in succession.

(Item No. 18-A on program is demonstrated, first speech, then music.)

Q. 3. Now, Mr. Waterman, what are these tests under the heading of the Second Test in Part 2, the tests numbered 19 to 26?

A. It has been testified that the early German flywheel Patent No. 387,058 is not operative to produce a substantial constancy of speed. That position was a surprise to me, and I had made no preparations to demonstrate that. However, when that statement was made I at once had a machine—which we had—rebuilt into such form that it may, I think, be taken as a thoroughly fair illustration of the German Patent No. 387,058. The characteristic of the machine of that patent is that the film is drawn through a sound head and then between two rollers, one of which has a flywheel on its shaft, and the film then passes around a roller which propels it, so that as the film is propelled through the machine, the film itself drives the two rollers, and hence the flywheel attached to one of them.

The PS16 machine passes the film through a gate, thence practically around a roller, thence over a sprocket, by which it is drawn through the machine. The roller and the flywheel attached to it in the PS16 machine are rotated by the movement of the film in response to the driving roller or sprocket, so that the machines are in this way comparable.

In both cases a film revolves a cylinder connected directly through a flywheel, and it is the purpose of this series of tests to compare the R.C.A. PS16 machine, one of those alleged to infringe in this case, with this model that I have had very hastily built, illustrating the early German patent.

Q. 4. Figure 1 of that patent, isn't it?

A. Figure 1. The model we will have a chance to see. In the drawing you find that the parts are arranged vertically one over the other. In order to get them into a talking motion picture machine it has been necessary to turn them on the side. The same necessity which Dr. Engl spoke of when he used the machine of Figure 1 of the patent, which shows the rollers one above the other, but which in his test machine, if I correctly understood him, were arranged horizontally. The same alteration has been made, purely for the reason that it was the only way that it could be gotten into the machine and use the optical system which was on it and the driving connections that were on it, and the casting itself would not have given room for the arrangement in any other way.

Q. 5. Now, will you proceed with this Item 19?

A. You will first hear PS16 reproduce from film in a speech record.

(Item No. 19 on program demonstrated.)

THE WITNESS: Now you are hearing No. 20.

(Item No. 20 on program demonstrated.)

THE WITNESS: The test just made I shall testify shows that this model of the German Patent No. 387,058 shows substantially as good approximation to uniformity in speed as does the PS16, in so far as so far tested by speech record. That is to say, I personally was not able to detect any difference between the rendering of the two, having its origin in speed fluctuations.

(Item No. 21 on program demonstrated.)

THE WITNESS: You are now hearing No. 21.

(Item No. 22 on program is demonstrated.)

THE WITNESS: You are now hearing the German flywheel patent in this demonstration.

Q. 6. Now, the next tests.

A. The next tests, 23 and 24, will be made in like manner, compared with the early German patent, but with a piano record. The piano record, in general, is one that enables most people to pick flaws somewhat more easily.

(Item No. 23 on program is demonstrated.)

THE WITNESS: You are now listening to the PS16, No. 23 on the program.

Q. 7. Now, what is this next?

(Item No. 24 on program is demonstrated.)

THE WITNESS: Now you are hearing the early German flywheel patent, No. 24 on the program.

Doubtless your Honor noted that the PS16 in this last test showed rather pronounced speed variations. Unless your Honor's ear was very good, you were not able to notice the same variations in the model of the early German machine. So far as I have heard it, it is more perfect in its speed constancy than is the PS16. Your Honor will under-

stand that when one is talking of uniformity of speed, we are talking about an unattainable ideal. All one can do is to approach as close as is desired for the purpose in hand, and therefore it is not represented that any test with any machine made this evening or that your Honor will hear at any time anywhere, with a rotating machine, will give perfectly uniform speed. These tests are laid out in such a way as to give your Honor an idea as to what these variations mean in the reproduction of speech, music and orchestra and piano.

The next test, Tests 25 and 26, is the constant note test of 512 cycles, which, as I said before, is a test that in the main is addressed to those who are accustomed to tests of this kind, and again I would like to express the caution that if you want to judge the records critically not to move your head either backward or forward or by rotation.

(Item No. 25 on program is demonstrated.)

THE WITNESS: You are hearing PS16.

(Item No. 26 on program is demonstrated.)

THE WITNESS: You are now hearing Test 26, the German model.

Your Honor doubtless noticed that there were pitch variations noticeable with both machines, but if your Honor's judgment agrees with mine, those pitch variations which are brought out by this test, were not such in either case as to destroy the usefulness of the machines for purposes of speech, orchestra and piano.

Q. 8. Now, the thing that is headed the third test, beginning with Item 27, what is the purpose of that, and what is that?

A. That requires some explanation. I will give it very briefly. The PS1 machine is provided with what

I think has been called damping means. It has a flywheel on the sprocket driving the film and that flywheel is driven by a spring connecting the drive gear with the flywheel. I should say by two springs. There are two spiral springs coiled within one another, that is, nested springs, enclosed in an opening or cavity cut in the central part of the flywheel, one end of which spring connects the flywheel, the other end connects to the driving sleeve, driven by a gear, to the source of power. That machine is inoperative for any commercial purpose when it is operated in that way. To make it operative, the damping is essential. The damping consists of a pad of felt, and constantly impregnated with grease so as to give what is known as viscous friction, and pressed by a spring-controlled lever against a trued-up face of the flywheel. This absorbs the energy which would otherwise go into oscillations.

I can perhaps take time to explain that somewhat more fully between subsequent tests, but first we are going to show what the effect is of playing the machine when the damping is removed. To do that we simply have arranged to pull on the lever, which normally compresses the felt against the flywheel so as to remove the pressure. The machine then will have its flywheel driven by a spring and without other damping than that which comes from the bearing, the film flexing and the like, that are common, of course, to all machines.

Q. 9. That would be Item 28. But first you are going to show Item 27.

A. First I am going to show Item 27, which is merely the machine in its normal capacity.

(Item No. 27 on program is demonstrated.)

(Item No. 28 on program is demonstrated.)

THE WITNESS: You are now hearing it with the damping removed.

Q. 10. What is the next, what is 29; same machines?

A. Yes. Except that the record that will be used will be the 512 cycle note, that is, the sustained note. And again the same caution holds, that if you want to hear what is actually being reproduced, you must keep still.

(Item No. 29 on program is demonstrated.)

Q. 11. This is with the machine in its regular condition?

A. This is the machine in its regular condition.

(Item No. 30 on program is demonstrated.)

Q. 12. Now it is not damped?

A. Now the damping has been removed.

Q. 13. What was noted then?

A. Your Honor noticed that the record that was just played contained what the laboratory calls a "wow." That is to say, the pitch constantly varied. Now, the reason for that is that any mechanical system which consists of a mass and a spring is what is known as an oscillatory system. The most familiar example of an oscillatory system is the balance wheel and hairspring of your watch, where the oscillatory capacity of a balance wheel and a spring are taken advantage of to keep time. The balance wheel gets an impulse from the watch movement which keeps it going —gets an impulse at each oscillation, which keeps it going; and it is oscillating at what is known as its natural period. And when you want to regulate your watch you change the length of the hairspring a little by moving a little lever which slides a loop along on the spring and changes the effective length.

It is that phenomena that is here involved and arises in all cases of a rotating mass and a spring where the frictional load is not enough to absorb the energy that goes into those oscillations.

Now, those oscillations may die out after a while, if no little impulse comes to keep them going. On the other hand, if the impulses coming from the picture projector or from splices in the film or from inequalities of gears or bad sprocket holes, anything which sets up an irregularity will introduce that "wow."

Q. 14. Now, Item 31 is a pure tone, which I understand is a note corresponding to 1000 cycles. Why do you have that, and what is Item 32 that you are going to compare with it, first?

A. This series of tests has to do with a model that has been prepared under my direction of Figures 5 and 6 of the patent in suit. The specification states towards the end that under certain conditions the flywheel may be driven not directly by the motive power but through the means of a small spring, which spring is strong enough to overcome the normal running friction. In order to prevent the spring from being strained at starting and stopping, two stop pins are put in the flywheel, and the driving arm placed between them. The exception being, as I understand it, that when the machine is running in normal operation this arm shall not touch the pins, but the machine shall be driven by the spring. Now we have here exactly the combination of mass and elasticity that constitutes what I have just been referring to as an oscillatory system. And Figures 5 and 6 differ from Figures 3 and 4 in just that respect. I suppose it is perhaps not improper to state that Figures 5 and 6 are not part of the application as filed, but a description was given of how Figures 3 and 4 might be altered, and in the course of the prosecution of the patent that alteration was illustrated by Figures 5 and 6. And, as described and as illustrated, it is exactly such a combination as is likely to set up oscillation.

And building a model as faithfully as possible to illustrate the patent, which your Honor will understand that the drawings of the patent are extraordinarily fragmentary, it has been necessary to supply many things that aren't shown, but we have made a good machine, with high-class workmanship, and the result that we find is that it is very much worse with the spring than without it; in fact, entirely inoperative.

Now, in order that your Honor may have first in mind what a tone without any speed variations would sound like, I have asked my assistants to throw on the loud speaker a tone from an electric oscillator, which will be a pure tone without any detectable variations in it.

When you are ready, we will have the pure tone.

(Item No. 31 on program is demonstrated.)

One understands that this is coming from an oscillator without any moving parts; purely an electrical affair.

Q. 15. The next is marked "Undamped Spring"; that means Figure 5 as shown in the patent?

A. That means Figure 5 as shown in the patent; with the spring constructed to comply with all of the conditions laid down in the patent.

(Item No. 32 on program is demonstrated.)

THE WITNESS: Now, to illustrate the effect of damping, I am repeating that test as Test No. 33, with an identical spring—not the identical spring but an identical spring, made to the same specifications, which has been stuffed with felt, wrapped in felt, and then bound in a rubber tape, so as to give it what we call damping. That is, energy absorbing power. Ready.

MR. MALLINA: You will have to wait for just a second.

THE WITNESS: All right; I can go on with my explanation, then, in the meantime.

This damping might have been applied as in PS1, for example, by a viscous damping pad against the flywheel, or some such thing as that; but the simple way, in order to avoid adding to the machine anything that the patent does not show as regards the flywheel was to simply substitute another spring of like quality, in which the energy consumption or damping capacity has been incorporated with the spring.

(Item No. 33 on program is demonstrated.)

THE WITNESS: Ask him to touch the flywheel with his finger.

MR. MALLINA: Touch the flywheel with your finger.

Q. 16. What happened?

A. You will notice that when I asked that the operator touch the flywheel with his finger, I started a "wow"—if your Honor will pardon that expression; I don't know what else to call it—and that it at once died out.

Now, the reason it died out was because of the damping. Your Honor also noticed that when the undamped spring was used, it did not die out; once it decreased perceptibly and then immediately began to build up again.

Now, in these oscillations one can never tell what is going to happen or when it is going to happen.

The machine may quiet down and run for some little time. But at the first disturbance which occurs at the right frequency, the stability of the system is upset, and put into the wowing condition.

Now, these Figures 3 to 6 have another serious inherent defect. So far as we have been putting up

with it. It is that the method of driving the film shown is defective, and that it is impossible without adding something not shown to keep the film in focus. In order to keep the film in focus I had applied something not shown in the patent, merely for the purpose of this demonstration, and which I call a "shoe," for lack of any better word. It is simply a little light metal piece which presses the film down very lightly, so that it does not rise and fall with respect to the sprocket.

Test 34 will show the machine as you last heard it, that is, with the damped spring, but with the film held down against the sprocket so as not to get out of focus and so introduce disturbances which are not due to rotative speed variation.

(Item No. 34 on program is demonstrated.)

THE WITNESS: Your Honor noticed that as it started up it was unstable for about two oscillations, which immediately died out.

The PS1 machine is normally adjusted to be unstable for three oscillations before coming into stable operation. Cut off.

Now, I put on the PS1 machine in its normal operation, just for comparison. No. 35.

Q. 17. At 1000 cycles?

A. That is at the same frequency, at 1000 cycles per second.

(Item No. 35 on program is demonstrated.)

THE WITNESS: Now, will you have him touch the flywheel with his hand.

MR. NEAVE: That is enough of that.

Q. 18. Now, what is that Amet attachment that is in Item 36?

A. There is a prior patent which so far has not been brought to your Honor's attention, which deals

with the operation of sound in talking motion pictures, and which provides for the proper synchronism of the sound with the picture and which provides for constancy of speed of the sound record by a flywheel and by drives the flywheel through, not a spring, but a resilient drive, which is inherently damped by wrapping the spring of Figures 5 and 6 of the patent in suit with felt and stuffing it with felt.

We produced what I called a damped spring. This drive of the Amet patent is resilient and inherently damped. It consists of a drum, narrow drum, half an inch, five-eighths, perhaps, in width; just an annulus or hoop with leather discs, one on each side, and the center of each disc provided with a suitable hub for connection to the shafts of the two machines; that is, one end connects with the shaft of the motion picture machine and the other end with the shaft of the phonograph.

In this instance the sound is produced, not by sound on film, but by a cylindrical record——

Q. 17. That is in the Amet patent?

A. In the Amet patent. Driven by the sound projecting machine.

Test No. 32, which has already been given, showed that the use of the spring as described in the patent in suit renders the machine inoperative. I have had one of these Amet "drives"—can I use that expression—resilient couplings, constructed, which can be put in place so as to connect the flywheel of the same model that we used to illustrate Figure 5, the undamped spring, and drive the flywheel in the manner contemplated by Amet. That test will show the effect of resilience with damping.

Mr. Neave: All right, Mr. Mallina.

Mr. Mallina: Ready.

(Item No. 36 on program is demonstrated.)

THE WITNESS: Your Honor will notice that when the model is driven by the Amet flexible drive the evidence of speed variation is extremely slight.

MR. MALLINA: Shall he touch the flywheel?

THE WITNESS: What? Well, you can have him touch the flywheel, yes.

MR. MALLINA: Will you touch the flywheel?

THE WITNESS: One and one-half oscillations was sufficient to substantially damp out the——

MR. NEAVE: What did you want to say, Mr. Ward?

MR. WARD: I do not like to interrupt, Mr. Neave, but I would like to ask the Court if he agrees with Mr. Waterman's statement here that there was no substantial variation in that record.

MR. NEAVE: Play Item 36 again. Unless they have changed it. Have they?

THE WITNESS: No, they can't now. It probably has been taken out. If you want to wait while they put it back, it will take about seven minutes.

MR. NEAVE: No. Go ahead with your No. 37 and we will do that after, Mr. Ward.

THE COURT: Well, you just drew my attention to what you thought. I do not know that I will express my opinion.

MR. NEAVE: Mr. Ward, we will run these again for you, if you want. But we do not want to keep running them now, because it will take too long.

THE WITNESS: Well, I may state my observations of this series of tests.

Of course, this is not at all the first time I have heard them. But the impression that I derive—and which I shall testify to—is, first, that as to Test 32, the test with the undamped spring was entirely uncommercial; inoperative from the point of view of sound reproduction. That with the damped spring that we applied—which is a crude affair; just simply did the spring up in felt—the improvement was very great indeed.

That the Test No. 34, where we applied a shoe to hold the film in focus, certain variations which still appeared unpleasantly prominent in Test 33 were decidedly minimized, and that 34 was a more nearly satisfactory rendering of 33.

The PS1 was by no means free from speed variations. But showed perfectly acceptable rendering for ordinary commercial purposes.

The Test 36, in which the same model used in Tests 32, 33 and 34 were driven by the Amet resilient leather coupling, in which the shoe was retained, was better than either 32, 33 or 34.

Q. 18. Is that shoe retained in the next test you are going to make, No. 37?

A. Yes.

Q. 19. And what is this Constable attachment that is going to appear in 37?

A. There is another patent in the prior art which has not been brought to your Honor's attention, which describes a phonograph drive. It refers to an ordinary spring-driven phonograph, having a governor and taking a cylindrical record, and it is driven by a spring in the form of a fork or a U-shaped piece on the end of an arm attached to the driving member. The driven member is loose on the shaft, and is driven only by the spring. Between the arms of the U is a rod, and the whole device fits into a mortise or niche cut in

the face of the spider of the drum—cylinder mandrel. So that the walls of that niche act as stops, so that the pin in starting and stopping, the pin works between the walls. In other words, we have a resilient drive with stops. There are two of these, one on each end of the driving arm, each fitting into appropriate diametrically opposite notches on the side of the spider.

Q. 20. Can you show that Item 37 now?

(Item No. 37 on program is demonstrated.)

MR. MALLINA: Touch the flywheel?

THE WITNESS: Yes.

MR. MALLINA: Will you touch the flywheel.

Q. 21. And what was the result of touching the flywheel, Mr. Waterman?

A. The result of touching the flywheel was to set the system in the inevitable oscillation of a spring and mass system, which died out. My attention was distracted and I can't say whether it was three or four oscillations. The reason it dies out is that these springs of the Constable structure press against the sides of the notch, and in their spring action therefore have a longitudinal component of motion with it, and that makes the whole system inherently damped to the extent that the test shows.

Of course, it was not entirely free from speed variations.

Q. 22. Before that flywheel was touched and after it had quieted down, after it had been touched, what do you say about the constancy of the speed as shown by that note?

A. For the purposes of speech and music it was entirely commercial. There were variations, just as there have been variations in all of the machines shown. I would say that the variations were slightly greater than shown in Test 36.

Mr. Neave: Your Honor, the rest of these tests, 38 to 48, are on the devices of the prior art that you have not been so unfortunate as to have heard of yet. That is, there are some patents that will be put in—this Constable patent, and the Bell & Tainter and Dragoumis, and you have not seen these yet; and none of these things, Items 38 to 48, have you seen except the Hoxie machine, which is one part of Item 46, and the Victrola machine, which is 48.

Q. 23. Now, Mr. Waterman, I suggest with reference to Items 38 and 39, which are the Constable machines, that you do not start to describe them further than you have, and of course when you come to talk about the patent, it will be very much clearer, because we will have the drawings before us, about just what has been done with reference to those machines, to make 38 and 39.

A. All right, sir. I will explain that.

(Item No. 38 of program is demonstrated.)

Q. 24. Is this Item 38?

A. This is 38, the Constable machine, running normally.

Test 38 showed the normal performance of the Constable machine. Now I am going to have the spring blocked, that is to say, put a little block of wood in there, so as to deprive the machine of the benefit of the spring drive, and it will then be just like a rigid drive.

The machine is a very small light one, as your Honor will see. The mass is relatively small, and the spring is useful when damped.

(Item No. 39 on program is demonstrated.)

Q. 25. What do you say of that rendition of the waltz?

A. I do not think it is necessary to say much. I do not think anybody would want to listen to it very long. It is very bad, and the defects are due to speed variations.

Q. 26. Item No. 40 is the Edison "Skeleton." What do you mean by an Edison "Skeleton?"

A. The patent in suit represents that the machines of the Edison type with the cylinder get rid of some of the irregularities of motion in virture of the weight of the record. So I have had a shaft with its flywheel taken out of a machine, such as the one in evidence—which is known as the Edison Triumph machine—and simply mounted in bearings, and a small sprocket put on, so that we can put a film on it and a little piece of endless film, I believe we have on this, and run it to show what order of speed constancy it is able to give.

The justification for doing that comes from the Edison British Patent, to which I shall call your Honor's attention, and which shows such an arrangement of a sprocket with an endless film running around it.

MR. NEAVE: Operate No. 40.

THE WITNESS: No. 40, whenever you are ready.

MR. MALLINA: 40.

MR. WARD: How does your man out there know what to operate? Is there anyone communicating to that room as to what is being run?

MR. NEAVE: He is asked to operate No. 40, and he has the same program.

(Item No. 40 on program is demonstrated.)

THE WITNESS: This test No. 40 has been made with a film, not recorded, however, by light, but by mechanical recording, the record simply being pressed into the film.

This was done under my direction and corresponds to what would have been necessary in the prior-to-light-recording in making a record on film.

The next test, marked 41, is test of a Bell & Tainter machine. I shall refer to the Bell & Tainter patent. That patent describes the use of a record on a tape. The machine is provided with a flywheel, and there is a model of it in the National Museum of the Smithsonian Institution at Washington.

I notice that the programs seemed to differ. The record that I am going to play is a waltz, and so stated on my program; but I notice on some of the others that have been recopied, an error has been made, and it is put down as a speech.

MR. NEAVE: By that you mean 40 or 41?

THE WITNESS: It means 41.

MR. NEAVE: It is a waltz in mine.

MR. WARD: My 41 says march.

THE WITNESS: Then there are three different. Well, in order to get copies enough, they have been copied several times, and evidently that particular——

MR. WARD: 41 is a waltz.

MR. NEAVE: 41 is a waltz.

MR. MALLINA: Yes, it is a waltz.

THE WITNESS: Now, this Bell & Tainter machine carries an extra narrow tape, hardly more than a quarter of an inch in width. The patent itself describes the tape as made of paraffine paper. The record that I am using, however, is made of celluloid, rubbed in just as described in the case of the last test.

In making of this model I have followed substantially the model as shown in the Smithsonian Institute.

THE WITNESS: This is not, of course, being made with the mechanical reproducer, for the reasons that I have stated. All of these are being made with electrical reproduction, amplification and rendering by the loud speaker.

THE WITNESS: If he is not ready with the Bell & Tainter, he can play the Dragoumis, 42.

The Dragoumis model is made to represent the French patent to Dragoumis, which is addressed to a film phonograph, in which the record is made on an endless strip and supported by suitable tensioning means, and runs over a cylinder from which the reproduction is taken while the film is stretched tight around the cylinder, and the cylinder shaft has upon it a large pulley, by which it is driven by an electric motor, the pulley serving as the necessary flywheel, or momentum effect to give the constancy of speed.

The record that I shall use is made on film by rubbing in—as I have already described—and is a continuous loop. And they will run it long enough so that the splice will have time to go round several times.

Q. 27. That is, the sound here is not photographically recorded?

A. Not photographically recorded. As the patent shows, it is mechanically recorded.

Q. 28. On a film?

A. And it is mechanically reproduced with the stylus, which, however, operates the mechanism of an electric pickup.

Q. 29. Would you have any difficulty in having that kind of a film made?

A. None whatever. I requested that it be made. They told me that they never had done that, but they saw no difficulty in it. I went down and saw it made.

MR. NEAVE: Mr. Ward, that film of course is here for you to see.

MR. WARD: You mean as the Dragoumis patent shows. You said "the patent shows."

MR. NEAVE: Which is ready now.

MR. MALLINA: Play Dragoumis first.

MR. NEAVE: All right, this is 42.

MR. MALLINA: 42, Dragoumis.

THE WITNESS: "Dra." on the board stands for Dragoumis.

(Item No. 42 on program is demonstrated.)

Q. 30. Are you going to play a march on the same thing?

A. Yes.

Q. 31. And the march is recorded on a film in the same way as this last film which you spoke of?

A. Yes.

(Item No. 43 on program is demonstrated.)

THE WITNESS: It is a little too loud.

Q. 32. Now, as regards 44 and 45, that you mark reel film, the speech and the waltz, are they films made in the way as those used in Items 42 and 43?

A. Exactly the same way.

Q. 33. But merely longer lengths?

A. Only they are longer films. And they are, again, to illustrate the fact that in a simple revolving wheel the weight of a record is not necessary to the production of substantial speed constancy. There is no difference between film and the cylinder in this respect.

(Item No. 44 on program is demonstrated.)

MR. NEAVE: What have you got now?

MR. MALLINA: 44.

MR. WARD: This is Dragoumis again.

MR. NEAVE: Is this Dragoumis? It isn't Dragoumis?

THE WITNESS: No. It is 44, reel film.

Q. 34. Well, what kind of a machine is it on?

A. It is no particular kind of a machine. It is just a shaft with a wheel on it and a sprocket.

Q. 35. It is electric pickup, you mean?

A. Electric pickup, yes.

MR. NEAVE: All right, you can see that outside, Mr. Ward.

MR. NEAVE: Can you cut that? That is enough of that, isn't it?

THE WITNESS: Cut it.

This test was intended, among other things, to show there was nothing impractical about making mechanical records on film.

MR. NEAVE: Your Honor, we are having so much of this particular kind of a film with a sound record cut mechanically on a film, instead of being put there photographically, because we understood Mr. Ward to say that it could not be done, and we were just illustrating that it could.

Now, have you got the waltz?

(Item No. 45 on program is demonstrated.)

MR. NEAVE: That is enough of that, Mr. Mallina.

THE WITNESS: I just went out to see what is the matter with the Bell & Tainter. It seems to have a broken belt. We will just drop that.

Q. 36. Mr. Waterman, Item 46, that is the Hoxie machine that was in court this afternoon, wasn't it?

A. It was.

Q. 37. Now, what is the film that you are going to show on that machine?

MR. WARD: One moment, Mr. Neave; which is the Hoxie machine? The reproducer?

MR. NEAVE: Reproducer, yes. Exhibit 45, isn't it?

Q. 38. And what is the film you are going to show on that machine?

A. The film is one recorded by Mr. Hoxie, and I understand is the original film. I have never heard it. We have been playing reproductions of it, copies of it here, but I have never heard the original we are going to hear now.

MR. NEAVE: Mr. Ashton, when was that recorded?

MR. ASHTON: It was recorded on March 8th, 1921, and reproduced the next day, which was March 9th.

MR. NEAVE: That will appear from the testimony when Mr. Hoxie testifies.

THE WITNESS: And the date appears in the record.

MR. NEAVE: Yes, the date is spoken.

THE WITNESS: The record consists of a description by Mr. Hoxie, being interrogated by someone else, as to how the record was made, and when.

Q. 39. And this was a film that has only sound on, is that it, it is not a picture record?

A. A speech, you mean. No, it has no pictures.

Q. 40. It has no pictures? That is what I am trying to find out.

A. No; no pictures.

MR. NEAVE: All right. Now are you ready?

THE WITNESS: Also it has no music. It is simply a conversation between two men.

(Item No. 46 on program is demonstrated.)

MR. NEAVE: You have copies, haven't you, of the wording of this?

MR. ASHTON: Yes, I have.

MR. NEAVE: And we will put them in evidence later. Don't run any more of the film.

THE WITNESS: Do you want to run the rest of the film?

MR. ASHTON: I think we should.

MR. NEAVE: All right, go ahead.

Now, when you say the other side, you do not mean the other side; you mean the other edge of the film, don't you?

MR. ASHTON: There are two strips, two sound tracks recorded in the film.

MR. NEAVE: Both on the same side of the film?

MR. ASHTON: Yes.

(Colloquy off the record.)

MR. ASHTON: This side was recorded the first day and reproduced the same day, and the other you have heard.

Q. 41. Now, while they are making that change, Mr. Waterman, what is this "General Phonograph," Item 47?

A. That is a model representing a French patent, Compagnie Generale something or other. We have

been accustomed to say, for short, General Phonograph. It translates "The French General Phonograph Company."

Q. 42. Well, it is a model of something that is shown in a patent?

A. Shown in a patent later to be explained.

(Item No. 46 on program is demonstrated.)

MR. NEAVE: It is a continuation of the Hoxie film.

Q. 43. Now, you have spoken of what Item 47 is. Will you have that put on as soon as it is ready?

A. Tell them to put on 47 whenever they are ready.

MR. NEAVE: This being a model of the French patent already spoken of.

(Item No. 47 on program is demonstrated.)

THE WITNESS: This is, of course, a commercial record. A commercial record. "Hungarian Rhapsody."

Q. 44. Now, Mr. Waterman, will you put on Item No. 48, the Victrola.

A. The Victrola that will be demonstrated is the one that has already been introduced in evidence in court, and the same record will be played on it, that "Hungarian Rhapsody."

MR. WARD: That is the big cabinet you had there today?

THE WITNESS: Yes, the big cabinet that was in the court.

(Item No. 48 on program is demonstrated.)

MR. NEAVE: Does that complete our program?

THE WITNESS: I may say that I am responsible for that selection. We heard the same thing over and over again, so that I thought perhaps the

Court would like to have it end up with some real music, so I selected that "Hungarian Rhapsody."

MR. NEAVE: Your Honor, that ends our demonstration.

Speaking on behalf of the defendants, I want Mr. Ward and his associates to have every opportunity to examine the apparatus they have been hearing, in every way that they choose, and we will give them every facility for it. And as far as the defendants are concerned, we will put no restrictions of time upon them at all.

As far as the Court is concerned, of course you do not want them to go out there and spend an hour in the other room and have you wait and come in here and cross-examine Mr. Waterman. And I do not know what Mr. Ward has in mind. I do not know whether he has some questions he wishes to ask now.

I should think you would want to defer your questions until you have examined the apparatus.

MR. WARD: Your Honor, I should think we probably need an hour to examine all these machines and know what we are going to ask about. I do not know what they have got behind the scenes here.

MR. NEAVE: Your own people have seen them, so they are not behind the scenes. Your people are out there.

MR. WARD: I mean I do not know how to ask the questions.

MR. NEAVE: Well, don't you think the best way of going on would be for you to spend the rest of the evening, as much as you want, examining that apparatus? If you do that, and talk with Mr. Waterman informally out there—I mean not on

the record—you can soon boil down, can't you, in your own mind what questions you want to ask him, and probably be able to conduct your cross-examination in open court, without being here—which are uncomfortable quarters.

I will also say that I have no reason to suppose that apparatus is going to be moved in any way. So that if you want to come and see it again tomorrow evening, there is no reason why you can't do it.

But I should hope you would spend all the time you could here now, and then proceed with Mr. Waterman tomorrow, after we get through with our fact witnesses.

THE COURT: Then we consider the court as a court will adjourn here, and Mr. Ward can examine the apparatus outside.

MR. NEAVE: As long as he chooses.

THE COURT: He can examine that apparatus outside and be ready for their cross-examination tomorrow morning in court.

MR. NEAVE: Perhaps not tomorrow morning. We want to get through with our fact witnesses first.

THE COURT: All right.

MR. NEAVE: There are only two or three more fact witnesses, and get through with them; and then go on with Mr. Waterman.

MR. WARD: Mr. Neave, will these machines remain here in case we ask for a repeat of any of these demonstrations?

MR. NEAVE: Yes. That is, not forever. During the course of the trial.

MR. WARD: That is what I mean.

MR. NEAVE: Oh, yes; except as they have to be carried off to the Court. I do not know whether they have to be or not.

MR. WARD: Your Honor, is Mr. Neave's suggestion agreeable to you that we adjourn now?

THE COURT: Yes, perfectly satisfactory.

MR. NEAVE: I have spoken to your Honor about Mr. Ward and his associates seeing those machines. You may be interested in looking them over too.

THE COURT: I am just wondering if it would be advisable——

MR. NEAVE: You will see them again.

THE COURT: —for me to go out there while he is examining them.

MR. NEAVE: Well, they are very close quarters out there.

THE COURT: I may want to come down and look them over with both sides after we are through with the evidence maybe.

MR. NEAVE: Yes, I think perhaps you would be more interested in it then.

MR. WARD: I think maybe you would like to take the first blush glance at them tonight.

MR. NEAVE: Yes. Why don't you just walk through there?

THE COURT: Then we will understand we are through here now, so far as taking down testimony, and then we shall adjourn to tomorrow morning at ten o'clock.

HENRY A. TAYLOR, resumed the stand.

RE-DIRECT EXAMINATION (Continued).

By MR. ASHTON:

The speeds of the mandrel shaft of the recorder and reproducer of the Kinetophone system were 120 r. p. m. They had to be the same in both cases. The auditoriums in which I gave demonstrations of the Kinetophone were mostly small auditoriums, averaging maybe 120 feet in depth. I don't believe the audience had difficulty hearing in these auditoriums.

RDQ. 406. Did you ever have the experience of people walking out when you were showing in the small auditoriums?

A. I never knew anything about that.

RE-CROSS-EXAMINATION.

By MR. WARD:

These drawings which were introduced in evidence here yesterday, as Defendants' Exhibits 17, 18 and 19-A, B, C and so forth, were received by me from a special messenger from Orange. My knowledge of these tracings and familiarity with them is substantially the same as my knowledge and familiarity with the assembly view, Exhibit 17, that I testified about before.

I referred to the speed of the Edison recorder and reproducer, that is, the mandrel shaft speed. I did not examine the Edison Triumph machine that was in court here yesterday. I had no knowledge whatever of that machine as it was put out in the market. That had nothing to do with the talking pictures. That had no connection with the talking pictures. That had no connection with the Kinetophone. I am talking now of the recording machine that Mr. Webber had here. I had no connection with that equipment. I used the

larger machine known as the Edison Kinetophone for reproducing. And for recording we used that machine which you have here, the tracings of, these tracings.

RXQ. 422. Then you never used the so-called Edison Triumph model for recording?

A. We used a spring motor.

The machine as it was here in court yesterday was never used for recording talking pictures. I have seen those machines as were shown here. I did not have a chance to examine the bracket that went around that machine to hold the outer bearing shaft of the mandrel. I never had any necessity to examine it. I did not examine the amateur workmanship on that bracket where it was cut out with a jigsaw to fit around.

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JACOB T. TSCHOPP, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

(Defendants' Exhibits 43, 44, 45, 46, 47 for Identification are now received in evidence and so marked.)

I live in Schenectady, New York. I started to work for the General Electric Company in 1912. I was transferred from the experimental department to the standardizing department in 1916 as a model maker. I have been there ever since.

I first saw the machine, Exhibit 43, as it was originally when Mr. Steiner built it. I think he started in December, 1920. While it was being built I saw it every day practically. I worked alongside of Mr. Steiner. It was completed in January, 1921. I worked on this particular machine, Exhibit 43; I made a governor for

it. It was the conventional type of governor that is used on a Dictaphone motor, with larger balls on it, and stronger springs. I think it was in July, 1921, that I made the governor. I changed the springs on the governor. I used strong steel, spring steel for it. The balls on the governor were larger than for the Dictaphone governor. They were about an inch in diameter, as far as I remember.

Mr. Steiner and I made the machine over there, Exhibit 45. Mr. Steiner did something about building the machine before I began working on it. He got the material together and made some sketches. I do not have those sketches now. They were just rough sketches. They were thrown away.

I began work on the machine on the 10th of February, 1921. I got that in my time book. This is my time book. On page 134 is the entry, 10th of February, started to work on the photoelectric reproducer. The entries continue, except with holiday between, up to April 16th, 1921, the last page is 141; 140 and 141 are just the two whole pages of the book. That is, I used two pages for all of my entries, putting the title on the right-hand page, the shop order and the date on the left-hand page. All the entries for this period come under the title "Photoelectric Reproducer," except February 22d is a holiday and so marked with the shop order and the date; and also there is one Saturday morning that I had some personal business, which I marked "Personal."

I did some other work during this period in addition to the work on the reproducer itself. We built some wooden horns made out of a solid maple block, and I made some adjustable stands for the lens and vibrator holder. The wooden horns were used for recording.

The reproducer Exhibit 45 was completed about two weeks before my last entry there. That would be

the end of March, I think. I think it was the end of March because those wooden horns and the other work occupied me probably about two or three weeks, after the reproducer was finished. My entries are all entitled "Photoelectric Reproducer," because we never were told to call it anything else. It was probably all done under that certain shop order. It was all up to the foreman to tell me that, under what heading to put it and under what job order to put it. I was not given any new heading, not that I can see. It isn't here.

Q. 37. If your memory were wrong as to the machine being completed by the middle of March or the end of March—you testified—what is the latest day the machine could have been completed?

A. I don't believe my memory is wrong, because I am absolutely certain that I did make those wooden horns, and the stands. But of course I only prove I got this by memory and the other proof is of course my last entry in the book, that is April 16th, 1921.

Q. 38. That is, it could not have been finished after April 16th, 1921?

A. No, because it was completed when I left it there.

Q. 39. Does it appear from your notebook that the work on the machine was continuous?

A. It was.

I will read off some of the entries as to the amount of time I spent, beginning with the first entry on page 134: The first entry is February 14th, shop order 48104-338, photoelectric reproducer: 8 hours and 40 minutes. That is put for a whole week; and Saturday morning we only worked 4 hours and 40 minutes. That is 48 hours that week. The next week was a day less, it was a holiday. The next week was 48 hours again. And the next was again 48. And the third is 48. Also

March 21st to 26th in 48 hours. I stated that the first date in my book was February 14th; that is not correct, it is February 10th. The title "Photoelectric Reproducer" appears opposite the date February 10th, 1921. I repeated the title under the date of the 14th of February.

I know what parts of the machine, Exhibit 45, are not the original parts. The lamp housing and the motor, the reels, and of course the photoelectric cell and the pliotron are not original. The machine, Exhibit 45, was first operated right after it was finished.

Q. 50. What do you mean by right after?

A. Well, they never waited very long sometimes to try things out before they were finished.

I am certain a photoelectric cell and a pliotron, amplifier tube, were on the machine when it was completed, because I made the housing, the cell housing for it.

(Four photostats, copies of pages 134 to 141, inclusive, of notebook of Mr. Tschopp, February 10 to April 16, 1921, received in evidence and marked Defendants' Exhibit 48.)

Cross-Examination.

By Mr. Ward:

With regard to the Exhibit 43, I say that that was started in December, 1920, and completed in January, 1921; that is, in the condition in which it was first completed. When it was first completed I think the first few drives was hand-driven. As to whether it was hand driven in January, 1921, I don't say, oh, well, of course, that is possible.

**XQ. 56. Well, I don't want any possibilities about it. You are testifying as to very important dates here now. Was it completed with the hand drive in July, 1921?**

A. Hand drive?

XQ. 57. Yes.

A. No. That hand drive was discarded after a record was made. We found out that a hand drive would not do.

With the hand drive you could not get any even speed. The hand drive consisted of a little handle that you gripped with your fingers and you screwed into a flywheel. I did not try it out, but it was tried out. I understood it did not give any constancy of speed and it was taken off. I used to go and watch them, and also I understand that from the remarks that Mr. Steiner made. I was very much interested, and took a look now and then. And Mr. Steiner saw it tried out and talked to me about it. And I watched it, too, now and then.

After it was tried out with the flywheel and the hand drive I did not do anything on it except the governor. The motor drive was arranged for it, between the hand drive and the flyball governor. I had nothing to do with that. Mr. Steiner did that. Then I made the governor and I said that that was a three ball fly governor. Parts were taken from an Edison Dictaphone motor. I believe it was a conventional Dictaphone motor flyball governor?

XQ. 78. Do you know when that machine with the flyball governor that you have testified about was completed?

A. When the machine was completed with the flyball governor? The machine was completed some time in the middle of January.

XQ. 79. With the flyball governor on it?

A. The flyball governor was put on later.

It was completed with the flyball governor in July, 1921. The flyball governor was put on after we had the flywheel with the motor drive that was tried out first in order to steady it, to give the flywheel more

steadiness. That is, the flyball governor was used to get uniform speed in connection with the flywheel.

I could not make a rough sketch showing how that flywheel was arranged in the machine. I can show you in the machine where the ball governor was mounted. I am not a draftsman; I am a model maker. I could make a sketch, but I would not be very proud of it. I make sketches in my work often to throw them away afterwards. (Witness makes a rough sketch.) The brake bracket was fastened on the bearing bracket of the governor, I believe. I don't quite recall the exact application. In this sketch that I have made I show a belt going up to a device which I will mark "1." That device is a flywheel. But the belt ought to be on the periphery of the flywheel there. I will rub out the belt where I had it before. The shaft on which the flywheel is mounted has a gear which gears with a vertical shaft, which I will mark "2." That shaft carries the ball governors, which I wil mark "3." And then there is a collar, which I will mark "4" which slides on the vertical shaft 2. And that collar carries a disc, which I will mark "5." That disc does not engage anything. I have got it on the wrong side. I think it came over the top here. It ought to brake on this side. When the balls fly out the disc moves in; not out, like I had it before. Then when the sleeve 4 carrying the disc 5 moves up and down, it engages some surfaces. They could be moved. This disc 5 was adjustable. It was stationary, to produce a brake action. Those are indicated by the line I draw, which I have marked "6." So that if the ball governors are operated to move that friction disc 5. it engaged with some stationary fixture member. That put a brake on the shaft. That was to put a brake on the shaft carrying the flywheel, to steady it. If the brake was set once it kept the speed at that point. The disc only could move to wherever the

brake was set, and then it kept the speed there wherever it was set to, by a braking action.

XQ. 110. So the braking action varied as this disc 5 moved up and down, that varied the braking action to regulate your speed: right? Couldn't do it otherwise, could it?

A. Wherever the disc was set to, it moved up to the point and there it was the braking action.

XQ. 111. What?

A. And there was the braking action applied to it.

It seems to me that you want me to say that the governor was moving constantly, changing its position. The disc operated by the governor does not move up and down. When the flywheel comes up to speed the balls fly out and the disc moves against the braking surface and stays there. Suppose that your machine checks down in speed, the balls are closer to the shaft, the disc will move away from the braking element, and that varies the braking action. If the balls move out on the shaft the disc moves into the engagement with the braking member and increases the braking action. That didn't happen there, because the speed was always up, so that it was a continuous braking; it was not varied.

XQ. 120. Why did you have the balls on there that could move in and out, if you had a continuous braking action? Why not just have a disc operating up against the stationary member?

A. The motor was running at much faster speed than was needed.

XQ. 121. Well, that has got nothing to do with my question. I say, if you did not need the varying braking effect, why didn't you just arrange your rotating disc to come in engagement with the stationary disc, to give you a constant braking action.

A. With a stationary disc?

XQ. 122. Yes.

A. That would induce too much friction.

With regard to Model 45, I say that I began work on that on February 10th, 1921, and that it was completed in about two weeks before my last entry, which is April 16th. That is, completing it about two weeks before that, is based on my memory of occasions back in 1921. The number 48104 shown in my time book is the laboratory order. The 338 number, I think, alludes to the job. And if I have any 338's further on in my book, I think they will allude to the same job after the middle of April, 1921. We do not have more than one job to the same number, but there is a good many things that connect with that job, like for instance the lenses and vibrators. I think that all work on the lenses and vibrators was finished by April 16th, 1921. I can state that after April 16th, 1921, I did no more work in connection with that machine, Exhibit 45, if my book don't show it. If my book shows any further work, I did further work on it. But it doesn't show it.

Those orders were given to us by the foreman. He says, "Now, you put your time on 333 on this work," and I didn't have nothing to do with that. I put it down in my book the way the foreman tells me, regardless of what I am working on. If the foreman told me that I was working on the same work that I had been calling 338 and if the foreman told me to call it 333, I would call it 333. I would call it anything he says. I might have been working on anything else under 338 if the foreman told me to put it 338. I find that under date of April 11th to 16th I have work down under 48104-333, not 338; and I find that on the opposite page I have opposite those items written "Photoelectric Reproducer." The item shown at the same page entitled "Phonograph Recording Device" means that we started work on some phonograph. I don't quite remember just now what that

was any more. We made a spring motor, it was a recorder. I also find that those items entitled "Phonograph Recording Device" are likewise put down under the shop number 48104-333 and extend down through the rest of page 141 to April 30th.

I referred to making some wooden horns and some maple blocks. They were made for recording, for the camera, I believe, for the camera, Exhibit No. 43. I didn't testify that that machine, Exhibit 43, was completed in July, 1921. It was completed in January.

XQ. 151. Well, with the governor you say it was completed in July, 1921, and you say it was completed with the hand crank in January, 1921?

A. No, I did not mean that at all.

XQ. 152. When did you mean that Exhibit 43 was completed?

A. I just was working on the governor to be put on that machine.

I converted the governor to be put on that machine, and I think that was done in July.

You want to know when I made the maple blocks and some other wooden structures for Exhibit 43, or for Exhibit 45. We made several horns. I might have made some for Exhibit 45 too.

XQ. 156. I don't want what you might have done. I want the facts. You are under oath and testifying to facts, or supposed to be. You told Mr. Ashton you made some wooden blocks for these machines or one of them. Which was it?

A. It was for this recording machine, Exhibit 43. It must have been in April, 1921, when I made them. The wooden blocks did not relate to Exhibit 45. This is a reproducer. We did not use a horn for reproducing, that is, no wooden horn.

XQ. 162. Wasn't 45 a reproducer?

A. It was.

XQ. 163. And it took a wooden horn?

A. No.

I don't believe anyone else worked further on Exhibit 45 after April 16th, 1921. There might have been a few changes done, but I think we had it pretty well completed the way it stands, except I think we put another governor on there too. We had a ball governor on it at first. We discarded it and put a tachometer governor on there. I saw the machine, Exhibit 45, after I got through with it on April 16th, 1921. I saw it after that whenever I was in the studio. I might have been called upon to work on it after April 16th.

I have referred to a pliotron. I do not know the difference between a pliotron and a dynatron. I suppose I would know a pliotron when I saw one. I would. A pliotron was the amplifying tubes in an amplifying circuit. I am not familiar with electrical circuits. As to what I meant by saying that I know what a pliotron is, we had so much to do with radio apparatus that I kind of got familiar with the names. All I know about it is that it is some kind of electric circuit carrying a vacuum tube. It is a vacuum tube used in a radio circuit or amplifying circuits. Vacuum tubes are used in all kinds of circuits.

I can tell you the difference between a photoelectric cell and a selenium cell. A photoelectric cell is a glass cell, and a selenium cell, I believe—you don't want my belief. I got a hazy recollection that I saw one. It was a pile of different metals.

(Sketch by Witness Tschopp marked Plaintiffs' Exhibit 37 for Identification.)

I know what a pallaphotophone is. It was a machine that we built later on. I don't believe that machine there, Exhibit 45, was ever called a pallaphotophone.

I forgot to state what are the items under May, 1921, in my notebook, page 144, with the shop number

333. I find another item No. 333 at page 148. I find something apparently erased and the words "Record cutting device" written in. I find on page 150 under No. 333, under date of August, "Phonograph Record cutting," some more items. By "Film Camera," on page 175, under date of April, 1922, is meant a Bell & Howell motion picture camera.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

I can state with respect to the large gear on this machine, Exhibit 45, whether the gear which I have marked 1 on the sketch, Plaintiffs' Identification 37, was of the same size or different. I believe it was the same size. It was the same size. As to the weight it might have been a little heavier than that.

I am asked to point out on Exhibit 43 the plugged holes where the governor was mounted. There are the holes.

MR. ASHTON: Note that the witness pointed to the two large rivets on one side of the camera, two of them being above and two of them immediately below the spring take-up belt.

(Tschopp sketch, previously marked Plaintiffs' Exhibit 37 for Identification, now received in evidence and marked Defendants' Exhibit 49.)

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CHARLES A. HOXIE, called as a witness in behalf of the defendants, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. ASHTON:

I live now on Riverview Road, in Clifton Park, New York. As to how old I am, I was born in '67;

sixty-six last February. I am a retired employee of the General Electric Company. I worked for the General Electric Company from July, 1912, to 1932. As to what work I did before I went with the General Electric Company, in the early part of my life I was a photographer about twelve years; and then for about sixteen years I was part of the time with power companies, in electrical work, and with telephone companies. I was wire chief for twelve years in different companies. As to whether I maintained my interest in photography, well, I hardly know what you mean by that. I maintained my interest to a certain extent. I was interested in photography. I didn't do much with it after I left the game, but I was interested to a certain extent.

When I first went with the General Electric Company I was developing instruments for the measurement of inductance, capacity and high frequency. And later I was placed in charge of the standards, of primary standards of inductance, capacity and resistance. Those were electrical matters.

I became interested in talking motion pictures. I began to be interested in December, 1920. As to how it happened that I became interested in this subject, during the war I had been developing an instrument for visual and photographic recording of wireless signals. Immediately after this I was developing a pen recorder for the recording of wireless telegraph signals, and while I was working on the pen recorder I was using a photo cell and a special vibrating mirror of my own, and it occurred to me that it might be used in connection with reproducing sound apparatus. I used a photoelectric cell in my pen recorder. I had light that was reflected from this vibrating mirror of mine, that was reflected onto this mirror, or focussed onto this mirror, then reflected into the photoelectric cell. And as the mirror vibrated it put more or less

light on the photoelectric cell. And in the photo cell circuit we placed a pliotron for amplification, and used the resulting alternating currents for operating the pen. That was an alkali metal photoelectric cell, a potassium cell. As to whether this work on the pen recorder had anything to do with my interest in talking pictures, it introduced the idea, that it might be used for sound reproduction, and we tried it out by actuating the diaphragm that held the vibrating mirror by sound, by talking against it, and the resulting vibrations that varied the light in the photo cell could be heard by means of a pair of phones in the plate circuit of the pliotron.

I can't recall exactly when I first knew of the alkali metal photoelectric cell as an instrument which I might use, but I believe, I know it was November or earlier; it may have been in the first part of October, 1920. I think it was brought to my attention this way: I think that someone suggested that I see Dr. Story regarding a device of that kind. I immediately consulted with him, and he told me about the photoelectric cell. I heard Dr. Story's testimony with regard to me consulting him; I agree with that testimony. Did I agree that he consulted with me in regard to his photoelectric cell? I can't remember all the details; there may be something I might disagree with, but I can't remember now.

I made the sketch you show me. I made it December 12th, 1920. I signed it on that date. That is the signature near the bottom at the lower right-hand corner. The subject matter dealt with in the upper half of the page was an arrangement that I conceived for the recording of sound on film. The instrument there entitled "Transmitter" was my special vibrating mirror that I designed for the other work. The little round circle right under the word "Special" is the light that is focussed on the mirror, by which the

mirror was illuminated. The mirror is shown at the end of the little rod attached to the diaphragm, at the extreme left. A man talked into the diaphragm, talking into the diaphragm, vibrated the mirror. The mirror varied the light entering the photo cell, shown at the left, the thing that looks like an eye, at the left of the electrical circuit shown there. As to what is the electrical circuit shown, as to function, the photo cell, the action of the photo cell acts on the grid of a pliotron, and thereby amplified, so that when the mirror at the other end or the coil to the magnet that actuated the diaphragm were placed in the plate circuit, it would vibrate this other mirror, in the output circuit on the right. The current is a pulsating current which actuates the diaphragm of the magnet. The little circle right under the little "p" near the right of the page is another light. The ellipse is the condensing lens by which we focussed this light onto the vibrating mirror. It was reflected then through a cylindrical lens onto a narrow slit, just in front of the moving film. The film is shown at the right of those two reels, one over the other. As to how the slit is indicated, there is a little division there; the line indicates the slit, also as shown in Figure 2-C. Figure 2-B is the picture of the sound as it would appear upon the film. That is a variable area record.

My attention is called to the words near the left in the upper division, "December 27th, 1920. This sketch observed by me," I think it is, "December 13th, 1920." Signed "F. B. Card." I recognize that writing. It is Mr. Card's writing. He was an assistant that I had working with me. Mr. Card put his signature in this notation on this sheet in my presence. As to when he put it on there, it must have been December, 27th; that is the date. Mr. Card observed this sketch on December 13th, 1920. I believe he saw it on December 12th, when I made it.

The arrangement shown in the lower half of the sketch is my conception of an arrangement for reproducing sound recorded on film. To describe it quickly: There was supposed to be, although it is not shown on the picture here very well, a narrow slit in front of the film, across which the film moves. A light, shown at the extreme left, is focussed by a condensing lens onto this film, and the light showing through the small slit into the photo cell. As the film passed the slit this light was varied with the record, and this varying change in the photo cell was amplified by means of a pliotron, which shows at the top of the circuit, and reproduced in a loud speaker at the right. The statement at the very bottom of the page reads: "The above in combination with the moving picture machine may produce what is known as talking pictures." As the moving picture machine I had in mind a standard moving picture machine, a projector.

(Hoxie sketch received in evidence and marked Defendants' Exhibit 50.)

I might have added that that slit spoken of in reproduction is shown at the bottom of the page in Figure 2-E. With regard to Figure 2-D the slit was directly in front of the photo cell. The slits were about one-thousandth of an inch wide. That applied to both recording and reproducing.

As to what I did after I made the sketch on December 12th, 1920, with respect to talking motion pictures, I immediately took steps to have a recording device made for the recording of this sound, and reproducing it. Exhibit 43 is the recorder and reproducer which I had made. I have heard the testimony of Mr. Steiner and Mr. Tschopp with respect to this machine. I agree with the statements which they have made as to the date the apparatus was made, the changes which were subsequently made in it, and its

original construction. I also agree with their statements as to the way it was used.

This apparatus, Exhibit 45, is a machine that I had made after reproducing the sound on the film. I have heard the testimony of Mr. Steiner and Mr. Tschopp with respect to this machine. I make the same statement with regard to that as I made in connection with the recorder and reproducer, Exhibit 43, as to the accuracy of what they said. That is correct. As to whether there is any change or any correction I would like to make, I don't know that you would call it a correction, except in the time of its completion. I know that when I wanted that made I wanted it in a hurry and I told them to speed it up as much as possible. I doubt very, very much that it was as late as the 16th of April before it was finished. I believe it was finished in the early part of March or not later than the middle of March. I cannot prove it, nor can I say definitely, but I believe it was the first part or the middle of March. I know whether or not the work on it was continuous. Of that I am as sure as I can be. I am sure that I pushed those mechanics for all they were worth. I hurried them. I don't think they had any great love for me on account of it. I was pushing them too much. I certainly know that it was pushed. As to whether I know that it was continuous, I don't know of their stopping. I was right there on the same floor. If they had stopped I think they would have heard from me.

You state that two records were reproduced last night at the demonstration, and it was stated then that they were both on the same film. You show me a film on a reel on which it is wound, and ask if I can identify it, I can. It is made of my voice on this recording machine. It was made the 8th of March, 1921. I know it was made on that day because I happen to know that it is the day before the date of this film.

The date on the film is March 9th, 1921. This date was placed on the film because we took the film over to the photograph house and had it developed and got it the next day. Mr. Card made this notation on the film. As to how I know Mr. Card made the notation, it is printed. I cannot say it is handwriting, but I am sure he made it. He made these entries on films for me. That was the practice. The number of the film appears on the end at which I have been looking. The number is No. 25. That means that was the twenty-fifth record that we had made on this machine, or the twenty-fifth record we had made from the beginning on this recorder, Exhibit 43.

You ask me to point out the two records on the film. You have unwound the film slightly. Here is one record on this side, and another record on this side. The end which I have been looking at is the end of one record. Well, it is the end of both. We made one first. As to how you start the film through the machine; the end you are looking at or the other, I believe this is the beginning of the first record. The beginning of the other record is on the other end. I have examined the other end of this film. It says practically the same thing, except that it says "beginning" instead of "end." I believe it says that. This is a negative record. I believe that was negative film. We commenced with positive film shortly after we started recording; but I am not sure. I think that is a negative film. I won't be sure.

Q. 98. Have you examined this film to see whether all the sound on it is the sound which was recorded on March 8th, 1921?

A. I have.

Q. 99. What is your conclusion after examining it?

A. What kind of conclusion?

Q. 100. As to when all the sound was put on it.

A. It is all on it, if that is what you mean.

Q. 101. When was it put on it? When was all the sound put on the film?

A. March 8th, 1921. I want to modify my statement about the positive and negative. Shortly after we started making records, we went to positive films. This may be the positive film. I won't say it is negative. It may be positive film.

As to whether this is the film upon which the record was made, it is the negative of that record, if that is what you mean. That is, the light fell on this film and made the exposure. That is the original film.

MR. ASHTON: I offer in evidence the original negative of the Hoxie Record, entitled "A New Type of Phonograph."

(Original record of Hoxie Record "A New Type of Phonograph," "by C. A. Hoxie," "Number 25," dated March 9, 1921, was received in evidence, and marked Defendants' Exhibit 51.)

I have had a transcription made of the sound which is on the record, both edges of the film. I believe the transcription which I now have, consisting of two sheets, is a correct transcription.

MR. ASHTON: I wish to point out that the Record Number 1 contains the statement that the film "moves past the point at a uniform rate of speed, in this case about one foot per second"; and that the Record Number 2 states at the end, "This record was made March 8, 1921."

I ask that these transcriptions be copied by the reporter into the record.

(The two typewritten transcriptions handed to the reporter by Mr. Ashton are copied into the record at this point, as follows:

(Record No. 1)

"A New Type of Phonograph #25
By
C. A. Hoxie 3-9-21 Beginning

A new type of phonograph. This speech is reproduced from a photographic record made as hereinafter described. A small mirror attached to a special device is caused to vibrate in unison with a diaphragm that is being actuated by the sound waves produced by the voice. By this means the edge of a beam of light reflected from this mirror is caused to vibrate longitudinally across a very narrow opening located in front of a photographic film which moves past the point at a uniform rate of speed, in this case about one foot per second. In this manner the sound waves are faithfully recorded upon the film.

(Question) What kind of a diaphragm was used in this transmitter?

(Answer) A thin mica diaphragm about an inch in diameter.

A description of the manner in which this, this speech is reproduced is recorded on the other side of this film."

(Record No. 2)

"A New Type of Phonograph End
by
C. A. Hoxie
#25 3-9-21

In order to reproduce the speech a strong light is projected into the photo-electric cell through an opening similar to the one described above, the light being varied by moving the photographic record in front of this opening at a

similar rate of speed that was caused to make, that was used to make it. The cell is connected in series with the battery and suitable resistances, current through which changes in accordance with the variations of light through the opening. This variation of current is made to produce a similar variation in potential on the grid of a small pliotron. The speech to which you are listening is the effect of the variations produced in the plate current of this tube.

(Question) I would like to ask how large an amplitude is required to reproduce satisfactory speech, or in other words how much space on the film is required?

(Answer) It has been found that a space one inch wide, one-eighth of an inch wide, is sufficient for all practical purposes, the variations seldom having an amplitude more than one thirty-second of an inch.

This record was made March 8, 1921."

You show me Defendants' Exhibit 47 and ask me if that is similar or dissimilar to the pliotron which I used in January, 1921. This is similar; or as far as I know, exactly like it, to my best recollection of the pliotrons used at that time. You show me the photoelectric cell, Defendants' Exhibit 46, and ask if this cell is similar or dissimilar to the photoelectric cell which I used in January, 1921. It is very similar; almost the exact counterpart. It is a potassium photoelectric cell.

This is a photograph of the reproducer, Defendants' Exhibit 45. The date of the photograph is July 21st, 1921. The photograph was taken July 21st, 1921. The photographs were taken in the plant of the General Electric Company, sometimes in the studio, and sometimes they came over to where we were and made them.

(A photograph, numbered 116072, dated July 21st, 1921, being a photograph of reproducer Defendants' Exhibit 45 in this case, was received in evidence and marked Defendants' Exhibit No. 52.)

As to whether the machine Defendants' Exhibit 45 had any number or whether we used any number in connection with it, I don't know just when, but a model number was given to the machine, No. 187, I believe; just when that was applied to that machine, I couldn't say.

(A photograph was marked Defendants' Exhibit No. 53 for Identification.)

This photograph, marked Exhibit 53 for Identification, is a photograph of the recorder, Defendants' Exhibit No. 43, after it was modified for use by the Oscillograph Department of the General Electric Company. That photograph was taken December 1st, 1921.

(A photograph was marked Defendants' Exhibit 54 for Identification.)

Defendants' Exhibit 54 for Identification is another view of the same machine after it was converted.

Defendants' Exhibit 53 for Identification, being a photograph of the recorder marked Defendants' Exhibit 43 in this case, taken December 1st, 1921, after recorder was modified for use by Oscillograph Department of General Electric Company, was received in evidence and marked Defendants' Exhibit No. 53.)

(Defendants' Exhibit 54 for Identification, being a photograph of the same recorder as Exhibit 53, showing another view of it after it was converted, was received in evidence and marked Defendants' Exhibit No. 54.)

This photograph is the next model that we made for recording and reproducing. This photograph was made on January 11th, 1923.

(Photograph made January 11, 1923, of model for recording and reproducing, received in evidence and marked Defendants' Exhibit 55.)

This photograph, No. 118,878, is a reproducer. The same, connected up as a reproducer. The same machine was used for the recording and reproducing. The light system was put on for recording and it was changed for reproducing. This photograph was taken January 11th, 1923.

(Photograph of January 11, 1923, No. 118,878, received in evidence and marked Defendants' Exhibit 56.)

This newspaper article is the same machine. We used to call that Model 177. The same as in Exhibit 56. Except that this was a later modification of the same machine. The date of the newspaper is February 18th, 1923. I am in the photograph. I could not say what the occasion for the taking of the photograph was. It was published throughout the world.

(Newspaper clipping of February 18th, 1923, received in evidence and marked Defendants' Exhibit 57.)

What was the question as to the occasion? You wondered where I was when the photograph was taken. I believe this was made in the laboratory. Why I hesitated is because I thought it might have been made while I was in Washington; no, that is wrong. We did not have this model in Washington. It was made in the laboratory of the General Electric Company.

(Group of photographs received in evidence and marked respectively Defendants' Exhibits 58 to 66 inclusive.)

You ask me to take these photographs, they are numbered Exhibits 58 to 66 inclusive, and state briefly what is shown in each photograph and when the photograph was made. The first photograph, No. 58, the date the photograph was made is April 17th, 1928. Can I refer to that model as No. 177? It shows the sound head of Model 177, if I may refer to it that way. It shows a part of it moved out so that we can see the inside of it. The inside of this shows the photo cell. On the further side it shows a grooved flywheel over which the multiple belt passed to drive it.

The next photograph, Exhibit 59, was taken, at the same time, April 17th, 1928, and shows how the film was passed through the machine.

The next photograph is entitled "Pallophotophone Recorder, Model 205." It was taken July 6th, 1923. I might say that this No. 205 refers to the upper portion. There is another model number given to the drive. I forget, I think that is 158 or something like that.

No. 61 is a view of the recorder model of No. 205; they are both recorders. Both of those that I have just stated is about recorder 205, different views of it.

Number 62 is a standard motion picture projector, which I equipped for reproducing the sound simultaneously with the picture. The reproducing equipment in this case is shown at the top of the motion picture machine. That photograph was taken on August 28th, 1923.

Number 63 is the next model that I made. I forget the number, whether it was 291 or 191. This was a picture that was made 1/28/26. It is a reproducer.

Number 64 shows that the picture was taken July 13th, 1926, and shows a Bell & Howell camera, on the top of which is mounted a recorder, I call it the pallophotophone recorder, model 291, with which I made simultaneously sound and picture.

Number 65 is the same machine showing the other side, and the flywheel on the drum that drove the film. The photograph was made July 13th, 1926.

Number 66 is a Simplex projector that I had equipped for reproducing simultaneously sound with the picture. That was made July 7th, 1926, the picture. That is all I have in my hand.

You ask me to state with respect to the group Exhibits 52 to 66, inclusive, which ones have flywheels on them and which have not, if any. The first one, No. 52, has a flywheel on it. The flywheel is that on which you see this little handle over which the belt from the motor runs. The next one has a flywheel, rather had a flywheel when it was originally built. That is No. 53. It had a flywheel on the sprocket that pulled the film down through the gate. The same is true of No. 54. Number 55 had a flywheel or large mass flywheel on the drum over which the film passed, and also a flywheel on the counter shaft. You can see the flywheel. The flywheel is mounted on the drum and also on the countershaft. It is right on the lower right-hand corner of the countershaft, and in the drum it is in the central portion, right underneath the magazines. The same is true of No. 56, as I have said as to the other one.

In the newspaper clipping, Exhibit 57, there is a large flywheel right on the drum shown plainly here on the side at the point where the film passed the light. And also on the countershaft below.

On No. 58 the flywheel is seen at the extreme right. The large heavy rings on that shaft also serves the purpose of flywheel effect combined with the flywheel shown at the right over which the belt passes. The same is true with No. 59.

On Number 60 it shows a large flywheel on the drum over which the film passed at the point where the record was made.

On Number 61, you cannot see the flywheel, but it is at the back, mounted on the drum shaft shown in the picture.

In 62, there was a flywheel on the sprocket just below the sound head. The sound head was at the top of the machine in this case, and where the film pulled down at the uniform rate on that sprocket in the motion picture machine, was placed a large flywheel.

On No. 63, there was a large flywheel placed on the drum that drove the film. It is around a glass drum, and on the shaft of that drum was placed a large flywheel, which can be seen on the back of the picture.

On No. 64, there was a flywheel, but you cannot see it in the picture, but it was on the drum over which the film passed, at which point the record was made.

No. 65 is a picture of the same apparatus, showing the other side, and the flywheel is plainly visible on the drum shaft.

On 66, I don't know whether I can see that flywheel or not in this picture.

There was a flywheel on the drum of that machine, but I cannot prove it by the picture. It may be there, but I cannot see it. The occasion when this photograph 66 was taken was that we were making a demonstration of talking pictures on the upper floor of the International General Electric Company's building at Schenectady. There were fifty or sixty persons there. I was trying to think of the names of some of them. The two people shown in that photograph are myself and Mr. Card.

In case I have omitted to refer to the dates of any of the photographs in this group of exhibits, I will state that the photographs were taken, all of them, on the dates which appear on the photographs. That was the custom of the General Electric Company, to always put the date on at the time they were photographed.

These photographs show all the machines excepting 43, that is, all of the machines that we have referred to here. We do not have any photograph of Exhibit 43 with the original flywheel on it.

I agree specifically with the previous testimony given as to how the flywheel was mounted on this machine. We mounted on the sprocket that drove the film a standard oscillograph flywheel. I can tell from the machine where the shaft was located. It was located at this point, just over a little bit, because the pulley was little larger. The sprocket on the machine was at the lower part of the gate where the film was pulled down past. The flywheel was outside of the machine. I can point out the exact location; it was right on that shaft. As to how large was the flywheel, we have one here in evidence. It was just like that, as I remember it. This is a standard make that the General Electric Company was carrying. We had lots of these flywheels around, the same thing, and we used one of these flywheels for this purpose. As to whether we made any change in the flywheel when we put it on the machine, nothing except that we might have turned off part of the small pulley on the right, possibly. At first, for the first four records, it was driven by hand, thereafter by a motor. The motor was like what you have in your hand there, that unit. That was a standard unit we had in stock. I am referring to Exhibit 44. You ask how do I remember that. Did I have anything to do with putting the flywheel on the machine. Well, I hardly understand the question. I was following the construction of that machine very closely. Mr. Steiner made it. I was in charge of this motion picture work.

I did other work besides motion picture work during the period covered by the photographs which have been put in evidence. I worked on phonograph recording.

(Hoxie sketch of arrangement for master phonograph recording, marked Defendants' Exhibit 67 for Identification.)

The sketch which I have in my hand and which has been marked for identification as Defendants' Exhibit 67 was a sketch of an arrangement that I suggested for the making of master records for phonographs. The sketch shows an arrangement that I suggested for making master records. I used a photoelectric cell and amplifier in this arrangement. They are shown there. The three rings at the left-hand side of the sprocket are supposed to represent that. I made this sketch December 12th, 1920. I signed it on that day. My phonograph recording was adopted by the Brunswick Phonograph Company. I could not give you the exact date, but I think it was some time during 1925. I was doing work on phonograph recording in 1923, 1924 and 1925. That is when I was working with the Brunswick Company. Well, I won't say I was working with the Brunswick Company in 1923. I think it was perhaps a little later than 1923. I could not say when I started. I was working on it in 1924 and 1925. I cannot remember the exact date.

I asked Dr. Story to get up a name for my sound on film machine. Well, I asked him in connection with, yes; I will say yes. By a little help from others, he did get up a name.

(Hoxie sketch, previously marked Defendants' Exhibit 67 for Identification, is now received in evidence and so marked.)

CROSS-EXAMINATION.

By MR. WARD:

I stated that I had heard the testimony of Steiner and Tschopp as to the building of the machine, Defendants' Exhibit No. 43, its construction at different

times, the changes made on it, and its operation, and that I subscribed to that testimony; that is correct as far as I can remember, yes. I have no notes or records on the subject of this machine, on the matters as to its construction and changes and operation. My testimony with respect to those subjects rests entirely on my memory back to the date that I gave.

With regard to the various photographs which have been put in evidence, running from Defendants' Exhibit No. 52, through Exhibit 66, you ask if I have had copies of any or all of these photographs in my possession since they were taken. I do not have any in my possession now. The General Electric Company had charge of the original negatives from which these photographs were made. The photographic department of the General Electric Company had charge of taking these pictures, that is, the original negatives, and filing them away. That was not any of my business. And so far as concerned any dates appearing on these photographs, aside from my general recollection as to approximate dates from memory, I simply accept these dates because I find them on the photographs.

I say I made the first three or four sound records that I ever attempted on the machine, Exhibit 43, as it stood in one of its former states of construction. That would be with the hand drive. I cannot remember how many records I made with that machine as it stood before the ball speed governors were put on, which the witnesses Steiner and Tschopp testified were put on. There were several. There might have been quite a number. I don't remember. I am asked to state what was the construction of the machine at the time that I made the sound record, Exhibit 51. We were driving it with a motor similar to that one over there, and one to the pulley with a flywheel on it; no ball governors upon it. This record was made before

the application of the ball governors. I made records on this machine, Exhibit 43, that involved a piano record or the playing of any music with maintained tones. I could not tell you when I made such records. I cannot remember that, ten years ago. You state that you know it is very hard to remember correctly ten years back, but that I have been doing some recalling of dates ten years back, the highlights. I certainly do not remember when I first made such a record as that. I have no such records with me. I believe the General Electric Company has some of them. I believe they have. Those records were made on this machine, Exhibit 43, and reproduced on this machine, Exhibit 43.

I have said that I made that record Exhibit 51 on the machine, Exhibit 43. You ask me to state briefly just how that record was made on that machine. I did not use a photoelectric cell in making that record. You ask me to describe how I got the record from the light on to the film. There was a lamp, and the light from the lamp was focussed by means of a condenser on to the vibrating mirror of a special construction of mine attached to a diaphragm. That was reflected through a cylindrical lens on to the slit just before or in front of the film. As we talked against the diaphragm, we vibrated that mirror, and that caused the edge of the light to go back and forth on the film making the record. The system of recording that I just described is different from the system outlined as Figure 2-A in this sheet of graph paper marked Defendants' Exhibit No. 50 to this extent; that all of this part, the part back of the last diaphragm, was not on this apparatus, but we talked against the last diaphragm, and actuated the mirror by the sound waves direct instead of going through. That is, I dispensed with this photoelectric cell and its amplifying circuit in getting the effect on the film. I did that because that was the most direct

way to do it. I later tried out this sketch here that I have just referred to. As to how much later, I would not dare to say. I didn't say that I did not use it when I was trying it out. I meant to say that I didn't use that scheme there until after the first few records were made; I don't know how many. As to whether after I used it and tried it out, I kept on using it or went back to the first system I have described here just now, that would depend entirely on what I wanted to do. In most of my recording with direct sound waves, if I wanted to use it at a distance, or a pick-up to a camera set at a distance, I had to resort to that scheme. I could record sound on film by talking directly against the diaphragm without the use of amplifying means, yes, perfectly.

You state that I referred to the use of a slit which is described in this Exhibit No. 50 sketch of mine as "narrow opening in photo cell," and referred to that as the slit about one one-thousandth of an inch in its narrowest dimension or thickness. I meant it was placed in front of the photo cell. I didn't mean to say it was inside of it, a slit one one-thousandth of an inch placed in front of the photoelectric cell. That first slit was simply knife edges, the upper one of which was adjusted by a micrometer screw. And it was one one-thousandth of an inch thick. You ask me how I could adjust that with respect to the globular PE cell that was up against the film. How could I adjust it? I don't quite understand the question. How would that prevent me from it? On the recording side the slit was on the outside of the box, or right in the, you might say in the partition here, right there, just; and the film was made to run next to the slit. The film is on the inside of the box. And the slit was within the partition, right there. As to how far the slit was from the film in the direction of the optical axis: That is right next to it. We had screens that kept it next,

right close to it. When I used the slit with a PE cell for reproducing, the slit was located exactly the same place, with the exception that this time—I don't show it here on this picture—but this time the light was thrown from the back of the box through a lens and focussed onto the film; the light passing through the film first and then through the slit, but it was close to it, just the same. The cell was on the outside of it. See, I show it better up here. The cell was on the outside of the box. Now, you ask me how far away was the slit from the PE cell in the direction of the optical axis in this arrangement where I was reproducing. Well, the cell was mounted on a kind of a stand, and was pushed up as close as possible to the slit, probably, oh, an eighth of an inch, a quarter of an inch, something, as close as we could get. An eighth of an inch or a quarter of an inch or something like that. We pushed it up against it, the round glass right up against it, so that it almost touched. So that the slit almost touched the round glass of the PE cell. We didn't have it on the box. Well, we might have had it touching, I don't know. It may have been touching. It may have been right on the box; but it was right as close as we could get it.

I used the machine, Defendants' Exhibit No. 43, for recording and reproducing in Schenectady, in the laboratory.

You ask was the film under pressure at the gate or optical axis in Exhibit 43 when I used it. Why, we had springs at the side, if I remember right. Perhaps I can't remember all those details, but I believe there was a spring at the side that kept the film close to it. And I do not know whether it is still in there or not. I don't hardly think so. You see, that has been reconstructed. You state that I have no means of knowing what that construction was at that time. I know it was a spring that held the film close to the slot, but I could not give the details of construction all the

way through except that that was true. You ask me to look at this exhibit and see if the springs that are in there now can function the way I state and to take the film and move it up and down. Those springs that are there now are not the springs that we used. That has been remodeled, and the oscillograph department has put on something of their own. It is not those springs. You ask if it is not pretty hard to tell from this Model 43 in its present condition just what it was originally. Well, I know that we had springs that bore on the film that would just hold it close without scraping or scratching the film. You state that we find more and more changes in this model as we go along, from its original construction. Others apparently know better than I do about that. I subscribed to the testimony of those other two witnesses, as far as I remember. I won't say that every statement they made I am in exact agreement with, but I think it was in agreement with what I would say myself.

With regard to Exhibit 45, the larger model over there, I say that I heard the testimony of the witnesses Steiner and Tschopp as to the building of that machine, its construction at different times, and its operation; and that I subscribed to their testimony with respect to it. As far as I can remember, it is about right. I have no notes or records with respect to the building, construction, changing and operation of that machine. I am testifying entirely from memory.

With regard to my Exhibit 51 sound record, the two sound records on that exhibit are both recorded on the same surface of that film.

The machine, Exhibit 45, was used in the laboratory, in Schenectady. I don't remember exhibiting that machine in New York City. I don't think we ever did. I don't think so. I won't say for sure, but I don't remember taking it away from the laboratory.

The General Electric Company never put out any of my recording and reproducing machines, such as Exhibit 45, for commercial use. I don't remember that the General Electric Company put out any commercial reproducers. That I believe was taken over by the R. C. A. or something. I knew you were talking about sound reproducing, of sound on film, when I gave my answer. And my answer is the same, as far as I know. I don't know of their putting out any.

I recall a visit by Mr. Sponable, of the Fox-Case Company, or the Fox Film Company, up to the General Electric Company somewhere around 1926 or 1927. I know that he made a visit there. Just what year it was I could not tell you. I should think it was somewhere around there. I cannot remember the details, but I believe I did demonstrate to him a machine that I had at that time. You state that as a result of that demonstration, the Fox people did not take any of those machine or ask to have them sent down. I don't think that had anything to do with it. I think it helped along rather than to prevent it.

I made some reference to the Brunswick Company making phonograph records by my system shown in my sketch, Exhibit 67. We made many records down there at the Brunswick Company for several months. We made several records down there similar to that, yes. You state that this sketch shows, as you read it in connection with my testimony given in connection with it, three photoelectric cells arranged in parallel and connected up to one amplifying circuit, and you ask if such an arrangement is operative. I don't know. We never tried it with three photoelectric cells. All of our work was done with one. This is only a suggestion as to how I thought it might be done, but we never used three. We used one when I worked with the Brunswick Company. You ask me if I know enough about the characteristics of photoelectric cells to know whether

or not they could properly function three connected together in one amplifying circuit. Do you want me to make a guess on it, whether it would or not? You are asking me whether from my experience with photo-electric cells and my uses of them, whether I know enough personally of their characteristics and functions to state whether or not they can properly operate to reproduce sound, when you have three of them connected up in multiple with one amplifying circuit. I don't know. Perhaps it might, and then again it might not. I don't know. I never tried it. You ask if I did much, if any, work to test out the characteristics and functioning of the PE cell except to put them in my machine and reproduce them. We made a lot of tests. From those tests I cannot answer your question, because we did not make that kind of a test. You ask me what I said with regard to whether the photograph, Exhibit 58, dated April 17th, 1928, had a flywheel, and what I meant as to how that flywheel was constructed. Well, I cannot remember the details of that flywheel, except that if I remember correctly, it was larger at the rim than this one here. It was something on the order of that perhaps (indicating). I won't swear to that, because to tell you the truth, I cannot remember so definitely, but I believe it had a rim like that, because that is the way we usually made the flywheels. That was not constructed of sheet metal. There were grooves in there to accommodate the small belt, the continuous belt wound around and around. Perhaps you have seen those kind, geared over a pulley, and over and over again, and then with the loop on to a separate pulley to make it continuous. I cannot remember how many wraps I had around that pulley to the belt, but you can guess at that as near as I can; perhaps five or six or seven, possibly.

Now, with regard to the photographs, Exhibits 55 and 56, you ask if those photographs show a machine

designed by me, or by Steiner, or by whom. This machine, we went together on. I had the idea in principle in my mind that I wanted a certain machine in a certain way. Then I got ideas from Mr. Steiner and we worked together on it. And many of the details of construction were furnished by Mr. Steiner. I made the suggestions and so forth, and that is the way we worked together on it. This machine came after my machines, Exhibits 43 and 45. The machine shown in photograph, Exhibits 58 and 59, they came still later. That was simply made to give someone a better idea of just how it was constructed. These photographs are dated 1928. They were made a long while after the machine was finished, of course.

As to whose design the machine shown in photograph, Exhibit 60, is I would say the same of this as I said in the other, that Mr. Steiner and I worked together, and most of the mechanical construction, you know, he, in details—both together. This disc-looking element at the lower left-hand side of the photograph, Exhibit 60, that you have your pencil on, is one of the balls of the governor, or one of the weights; it is not a ball, but one of the weights of the governor. There were two or three such weights on the governor, or more; there might be four. I don't know. I don't remember now. Three, probably. As to what those governors controlled, it was a limiting device for the speed; that is, the governor in those days, it was not so much to keep the speed—well, I don't know how I want to say that. But I have something definite to say. I will say it this way: in the shop circuit that we had in the laboratory it was very waving, that is, the 120 volts was used for all kinds of work in the laboratory. It varied as much as 15 or 20 volts, I should imagine, at times; and the result was it was not always good, no matter what kind of a balance wheel you had on

there, you never could keep it running evenly. So therefore we put a governor on this machine and then overrun the machine slightly and let the governor determine the speed of the drum. Can I say something else? If we had had a constant source, that is, such an A. C. such as we have now, or something of that kind, it is likely, or may have been, we never would have resorted to governors; because the balance wheels were good. I said the shop circuit varied as much as 20 volts out of 120. Well, I won't say 20. It may have been 10 or 15, very wide, anyway; very wide variations. That would very widely vary the speed of the motor. I had a direct current motor. And the object of these governors was to regulate the speed due to those fluctuations.

You say that the governors could not function unless you had fluctuations and that they necessarily moved in and out. But I will say this much: I have heard considerable talk about that governor today in this court and yesterday and the day before that. But those governors went up to a certain point and came to a solid rest. Now, the only fluctuations or running out or in of those balls would only be the pressure against that, which would be negligible, as far as movement of the balls is concerned. It might be almost perfect and still exert a pressure. And if the speed of your motor dropped down due to the 15 or 20 volts variations, it would still be up against the stop, of course, and be over-driving just the same. It would be up there all the time, be over-driving all the time, even at its lowest voltage it would be over-driving. I observed the operation of those balls when the machine was running. I have seen them run. As to whether they were always out and pressing that friction clutch up, it wasn't possible, as far as I remember, it was not possible to see any change in the spreading out of the balls. I don't remember of seeing any, I will say that. I never saw

the balls move. Now, it came against a stop, you see. Don't you see? It was pretty definite where those stayed, because they came to a solid stop, and only just varied the pressure.

You say I have been talking to Mr. Waterman about this ball arrangement. I don't know who Mr. Waterman is. You say I have been talking to some of these men around here. I haven't talked with anyone, except those that I—I will tell you. I didn't get that from anybody.

This photograph, Exhibit 62, shows an old standard, that is the name of the——. As to whether it was my design, or Steiner's design, or a joint design, well, that is the same thing as the others, Steiner's and my own, those suggestions up there. Of course, I suggested some. That photograph is dated 1923. I know whether that machine came before or after the machine of Exhibits 58 and 59, which photographs are dated 1928. This one came after the one. This was made a long time after it had been built; a long time after it had been built. That is, Exhibit 58, the photographs, were made a long time after it was built. The machine 58 was constructed before 61.

Photograph, Exhibit 53, shows my first recorders after having been modified by the Oscillograph Department for their work. I don't know whether it has been changed from this or not. All I meant by the testimony in respect to Exhibits 53 and 54 is that 53 shows the condition of it after it went to the Oscillogram Department. I did not have anything to do with it after it went there. You ask how do I know what this photograph shows. They asked for it and I was the one that gave it to them for the modification. It was not in this condition when I delivered it to them. It was in this condition afterwards. You ask me if I ever saw it and inspected it afterwards to know that these photographs

correctly show its condition after I delivered it to them. I don't remember seeing it in that exact condition, because it went from me, and I made them a present of it. I testified that this Photograph 53 shows it in the condition after they took it over. If I made a mistake in there, I can——. You ask me with regard to the photograph 52 of Exhibit 45, if I testified that that photograph shows the Exhibit 45 in its present condition or in the condition just after it was completed. Well, I believe that when it was first completed, if my memory serves me right, and I believe it does, that that governor was not of this type; it was a ball governor.

I know who Charles L. Heisler is. He was not associated with me in my work. Only I saw him very often back and forth and talked with him, but he never was associated with me in my work direct. I knew whether he was working on sound reproduction and recording in the General Electric Company. Edward W. Kellogg was in the research laboratory. He was also working on sound reproduction on film. Well, later, of course. It was after. John B. Taylor was one of many that was working on that problem considerably after I started it.

You show me a patent, United States Patent No. 1,756,864, C. A. Hoxie, application filed 1929, and issued in 1930. I am the applicant of that patent. The patent states, beginning in line 58, I believe it is, in page 1:

> "In apparatus of this character, where the film is supported and moved by a drum at the point of exposure, and the same is true of reproducing apparatus in which the film is supported and moved by a drum at the point where the record is read off the film, it is essential for the faithful recording of the sound, or reproduction thereof, in the case of a reproducer, that the drum rotate uniformly and that no slipping of the film occur on the drum."

That is in there. I suppose I read over this specification before I signed my application. I could not tell you if I did. I believe I did.

(Hoxie Patent No. 1,756,764, application filed 1929, issued 1930, marked Plaintiffs' Exhibit 38 for Identification.)

You show me another patent, United States Patent No. 1,758,794, to C. A. Hoxie, filed in August, 1927, issued May 13th, 1930, and ask me if I am the Hoxie of that patent. I am. On page 1 of that patent I read the following, from line 95:

"Drum 24 is driven by a separate small motor 38, which is provided with a suitable speed regulator or governor 39 whereby it runs substantially at constant speed."

The governor 39 is over to the right-hand side of the drawing. Wait a minute. Wait until I get this. (Examining.) There is one thing about this patent. This was driven by a separate motor here. I believe that statement is correct. It must be. You show me a certified file wrapper and contents of that Patent No. 1,758,794, and ask me if that is my signature to that application, to the oath in that application. Yes, that is my signature.

(Certified copy of file wrapper and contents of Hoxie Patent No. 1,758,794, marked Plaintiffs' Exhibit 39 for Identification.)

May I make a statement?

(U. S. Patent to Bardy, No. 1,258,298, marked Plaintiffs' Exhibit 40 for Identification.)

I would like to make one statement. I built that model around which that patent revolves, and it is my recollection that the upper motor from the drum did not have any connection whatever with the lower motor,

and in that patent it shows the governor there with some connection, and I cannot remember any such connection, despite the fact that the patent there shows it.

I know Mr. H. B. Marvin. He was connected with the General Electric Company. The Mr. Marvin that you referred me to, who I said was with the General Electric Company, is the H. B. Marvin of this article printed in the Transactions of the Society of Motion Picture Engineers, Volume 13, No. 33. I believe he wrote that.

As to when I first used one of my sound on film sound reproducing or sound recording machines in connection with a motion picture machine, in synchronism, I think the first, and I am quite sure, in fact, I guess I can state it as a fact, that the first machine was that standard projector. I believe I am right. I think that was somewhere around 1923. 1922 or 1923. Along that time.

THE COURT: Had anybody over here done that same thing at or about that time?

THE WITNESS: I was under the illusion that I was the first one. I don't know of any others at that time.

You ask me to point out on these photographs the standard projector which I referred to in my last answer. I point to Exhibit 62. You ask if when I ran Exhibit 62 I found that I had other sources of vibrations to contend with in the sound head. I don't remember. It seems to me, as I look back to it, that it was pretty good. You did not mean that. You meant the projection mechanism and the intermittent movement of the picture machine, and the gears of the picture machine. Did I find that I had to take care of those in my sound head operation? I cannot remember just what trouble I had there, if any. I don't remember.

You ask me if it is a fact that of the mechanical requirements for good reproduction, one of the most important is the ability "of the machinery to move the film past the sound record aperture at uniform speed, since pulsations in film speed due to non-uniform motion of gear, sprockets, and so forth, may result in bad reproduction. Weaving, curling, scratches, and dirt spots are other causes of mechanical distortion. The effects of optical devices on the quality has been studied and a design obtained which is free from all except inherent limitations; namely, those arising from the fact that an infinitely narrow slit is not attainable." Do I agree with that statement? I hardly understand that last statement there. I agree with all of it except this last one, and I do not understand it—that "which is free from all except inherent limitations; namely, those arising from the fact that an infinitely narrow slit is not attainable." I don't quite get what that means. I agree with it except for that sentence. I do not know what it means, that an infinitely narrow slit is not attainable.

I believe Dr. E. W. Kellogg, whom I said was with the General Electric Company, afterwards went with the R. C. A. Photophone, Inc., or with the R. C. A. Victor Company. That is my understanding.

RE-DIRECT EXAMINATION.

By MR. ASHTON:

Referring to Exhibit 62 which I said was the first reproducer and in which I reproduced sound and picture synchronously, there is a flywheel in that machine. I see part of it.

MR. ASHTON: Note that the witness points to the flywheel which, upon only casual examination, can be seen in the back.

I never made a machine for recording sound on film without a flywheel. I would not think of trying to get along without it.

I have just stated that Dr. Kellogg was with the R. C. A. Photophone. It was one for exploiting sound pictures and radio and devices, and so forth. They were exploiting a system that I started at least. The General Electric Company made recorders for the Photophone. I had something to do with those. I believe they made six. If I remember correctly, they made six projectors similar to mine, and also some recorders. They made fourteen, I believe, recorders for the R. C. A.

I recorded Coolidge and Weeks with my sound machine. That was down in Washington in the fall or December of 1921. Mr. Coolidge's record was broadcast from WGY, the General Electric radio station, on Christmas eve, 1921. It was recorded that same year, in December.

RE-CROSS-EXAMINATION.

By MR. WARD:

When I referred to the General Electric Company making recording machines, I was referring to sound on film. The recording that the Brunswick Company did that I said used my circuits was on discs. This Coolidge record I referred to was recorded December, 1921. That was after the record that I have here, Exhibit 51. As to when that was broadcast, I don't think I made a mistake in that year. I don't think that is '22, either is '21. Now, let me think. No. It was in '21. December, '21. That is from memory, too. I am giving you all this from memory. I have no records to show it.